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ORIGINAL ARTICLES

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Address*

By

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WE LIVE in a time when change is the rule. Just as we get our minds—and our programs—adjusted to a set of circumstances, along comes change and we are faced with what is sometimes a complete readjustment. Civil Defense is perhaps more subject to change than most other programs; for one reason, it is comparatively new. For another, developments in weapons have been nothing short of fantastic during the past few years, and the end is by no means in sight.

Until recently, we were bothered only by technological changes. The transition from the nominal atomic bomb to the multi-megaton nuclear bomb is an example. In the years ahead, we shall be faced with the transition from the carried bomb to the ballistic missile.

However, we can contend to some extent with such changes, because where the development is physical in nature, it can be combatted or contained to some degree by physical means.

Much more difficult to contend with is the climatic change—and I'm speaking of the international climate. Until recently we were faced with an admittedly unfriendly Soviet Union. Then came the Geneva conference, and suddenly Russian frowns turned to smiles.

The smiles have not yet been backed up by positive friendly action. Nevertheless, the changed Soviet attitude is having a profound effect, and I suspect that unless we are exceedingly careful, it may have further effects that will be most unfortunate.

To me, the changed Soviet attitude simply means that our negotiations for peace can be carried on in a warmer and more productive atmosphere. But the smiles of Soviet delegations do not necessarily mean that lasting peace will be readily achieved. On the contrary—Mr. Allen Dulles, head of the Central Intelligence Agency, tells us that he can detect no let up in Communist subversive activities. And we have seen a stiffening of Russian attitudes in some recent conferences.

So while we may be cheered somewhat by the Soviet attitude, and while we may pray that a friendlier atmosphere continues until the peace is assured, we must under no circumstances assume that peace has been finally won. We must not let our guard down.

It is important to keep in mind that neither military preparedness nor civil defense exist because of immediate threats to peace. The reason for their existence is not even long-range threats. The reason is simply that we must be prepared so long as any potential enemy is capable of starting a war. In other

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words, civil defense exists because weapons exist that may be used against us.

From the long-range viewpoint, we could not afford to dispense with either military or civil defense even if the international climate became entirely sunny.

It takes time to get a military force into being. We have found that out in previous wars. It takes months to recruit, train and equip a division or a wing. It takes years to get a Civil Defense plan into being, because—unlike our military colleagues—we have little precedent or experience on which to build. And we have little popular appeal. People would prefer not to think about Civil Defense. They would much rather accept hope as reality, and believe that we won't need Civil Defense because there will be no war.

Increasingly, we read and hear views that war is simply out of the question; thermonuclear weapons make the prospect of war so horrible that war is simply unthinkable. And those who hold such a view go on from there and conclude that, since war is unthinkable we can forget all about civil defense.

To turn the premises into a peculiar type of logic, we could set it up like this:

1. The need for Civil Defense grows out of the possibility of war.
2. Thermonuclear weapons make war unthinkable.
3. Therefore, Civil Defense is unthinkable.

Suppose we carry that line of false logic in another direction:

1. We need military forces for the defense of the nation in case of enemy attack.
2. No enemy would ever attack because thermonuclear weapons make war unthinkable.
3. Therefore, we do not need military forces.

I have not yet heard or read of anyone using this logic to suggest that we eliminate the armed forces, but if the premise that war is unthinkable is carried to its final conclusion, what other answer is there?

Obviously, the premise is not a sound one. Of course, war is unthinkable to men of good will and sound mind. It always has been unthinkable to such people—a fact that has never prevented war. I wonder if those who have plagued us recently with such logic are prepared to guarantee that the world is inhabited only by people who subscribe to their views?

It would be a grave error to believe that the philosophy of other nations is identical with ours. It would also be a grave error to believe that their logic is like ours. If we were of an aggressive disposition, we might be deterred from attacking a nation capable of retaliating swiftly and effectively. But this does not necessarily mean that all other nations would be deterred by fear of retaliation. We must remember that life and property, while valuable in America, are much less valuable in some other parts of the world. There are some places where human life, in our terms, has no value at all.

It is well to keep such things in mind before we grow overly optimistic. And another point to keep in mind is this: nothing that has occurred in recent months gives us any cause to believe that the Communist plan of eventual world domination has been abandoned.

Based on these facts, which are perhaps obvious, we can form our own statement based on sound premises:

1. Only a nation that is fully prepared can hope to survive a modern war.
2. There is always a *possibility* of war so long as weapons and means of delivery exist, even though there may be no *expectation* of war.
3. Therefore, prudent nations try to be fully prepared.

An essential part of preparation is the mustering of a nation's resources of materials and manpower. It is apparent that the nation's manpower resources cannot be physically mustered to any great extent. But manpower and material resources can be fitted into an M-day plan that will insure to the extent possible their complete and efficient utilization.

A medical plan for disaster provides a

very good analog for this kind of preparation.

A medical Civil Defense plan must take several factors into account. First, we must be prepared to treat casualties from nuclear attack. Second, we must be prepared to insure a continued sanitary environment, particularly under the circumstances of evacuation, for both casualties and non-casualties. Third, we must be prepared for biological and chemical warfare and the different kinds of casualties that would result from their use.

Even with evacuation carried out to the maximum feasible extent, the number of casualties from nuclear attack would be very great. Some of these would be casualties from the immediate effects of the weapon. And some would be casualties from fallout.

When we contemplate the possibilities of a nuclear attack on our major population centers it is immediately clear that our medical resources would not be adequate. Even with evacuation, I am not at all certain that our entire medical resources could handle the results in a satisfactory manner. Perhaps we have not put enough stress on the inescapable fact that our very best casualty care effort will not approach peacetime casualty care.

The medical profession has spoiled us, I'm afraid. When we become patients we expect and get individual attention. We expect all the skill and miracle medications available to be put into the job of treating our cuts and bruises. The man suffering from an attack of bursitis expects and gets the same consideration as the man suffering from a brain tumor.

I'm afraid the man suffering from bursitis will get short shrift in time of disaster, and the man with the brain tumor will just have to bear it a while longer. However, we can accept this: elimination of such things as elective surgery, cosmetic surgery and complicated techniques for diagnosis must be expected, and will be accepted. But we must prepare the citizen to face the fact that the terrible and ugly wound on his child will rate the attention of a physician only if the child is in grave and immediate danger of losing his life—and if a first aider is unable to handle the case. We have not told this parent that his child may not survive at all unless he, himself, is able to keep life in the patient by first aid means for what may be many hours.

These things will be true even if our medical resources are fully oranized. They are not organized now.

Physical facilities can, to some extent, be organized. Dr. John Whitney has described our stockpiles of medical and surgical supplies (page 260), and I think our progress has been at least satisfactory. We found some time ago that the Federal stockpile was the only answer to the supply problem.

It is now becoming rapidly apparent that a Federal plan is also a necessary first step in the organization of medical manpower. We have, of course, been working with the U. S. Public Health Service for some time on this question, and we have worked closely with the American Medical Association and related groups. But until recently, there was no organized attempt to bring all agencies of the Federal government together for the creation of a medical disaster plan that would utilize the facilities of all agencies.

A start has now been made on an integrated medical disaster plan. The Hoover Commission made a specific recommendation to the Congress in which it stated:

"That the Federal Government, in making plans for assignment of responsibilities during and immediately following an attack on the continental United States should include in its consideration of the problem the question of appropriate delegations of operational authority for directing medical care."

This recommendation pointed to a weakness in existing authorizations. FCDA, for example, has the responsibility for medical care under Public Law 920, but has no authority to direct the activities of people. The military services have authority over a number of people, including many with reserve commissions. Similarly, the Public Health Service has authority over many physicians through reserve or active commissions. But

nowhere is everything tied together into a workable plan.

The Department of Defense and FCDA attacked the problem simultaneously. We received an invitation from Dr. Berry of the Defense Department just as we ourselves were issuing invitations. And on July 6th, a conference was held with Department of Defense, FCDA, U. S. Public Health Service, Veterans Administration, American Medical Association, and Rusk Committee representation.

This meeting was followed by another, on September 1st, called by Dr. Berry, and chaired by Dr. Cushing, Deputy to Assistant Secretary Berry. The delegates from the agencies represented were formally designated as the "Committee on Medical Planning for Disaster." It will be the job of this committee to develop a national medical plan for disaster—and I must say that I do not envy the members their assignment.

What will come out of the committee deliberations is not clear at this time. We may find that new legislation is required before a national medical disaster plan can become effective. Certainly it will take the best talents and experience of all agencies concerned to devise a workable program that will be acceptable to the medical professions.

We are late in getting started—but we probably are not too late. And the end result will have a direct effect on this association, and all other associations in the medical field, be they civilian or military. This is inevitable, since modern warfare does not distinguish between types of clothing. If modern weapons are capable of making civilian and soldier common victims of disaster, then we had better band together in the common cause of defense against those weapons. There is no other way.

The Hematopoietic Effects of Irradiation Injury*

By
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THE deleterious effects of ionizing radiation on the hematopoietic system were recognized soon after the discovery of the x-ray by Röntgen (1895). The clinical experiences of marrow aplasia and pancytopenia among the unprotected workers in this new field early led to precautionary measures. The isolation of radium (Curies, 1898) extended this hazard. The industrial risks of such exposure were revealed by Martland's observations of grave anemia and leukopenia among workers with luminous paint containing radium and mesothorium compounds. These changes follow a transient phase of apparent stimulation.[1, 2] In principle, radium and thorium with alpha and beta particles lack deep penetrability. Their action on the hematopoietic apparatus is much more apt to occur if they are ingested or introduced into the body. The workers with luminous paints were accustomed to wet their brushes with the tip of the tongue. On the other hand, x-rays and gamma rays have the property of deep penetration and exert their destructive action upon external application. The extent of the damage will be modified by the intensity, duration and location of the exposure. Indirect effects of x-rays on the blood and the blood-forming organs are common, despite the rule of the dilution of action by absorption upon the passage through tissues less susceptible to radiation injury. While single massive exposures may induce major hematopoietic catastrophes, repeated lesser insults may ultimately lead to dangerous histologic derangements in the marrow, spleen and lymph nodes. Individual sensitivity apparently plays an important role in the total effect of ionizing irradiation. The hematopoietic injury may become manifest years after the exposure.[3]

Early experimental studies on the hematopoietic effects of x-rays established a depression to aplasia of the marrow as the basic explanation for the peripheral blood picture. More recently, Kahn and Furth (1952)[4] have reviewed the mechanism of post-irradiation anemia. They determined that in spite of a reticulocytosis the erythrocytes of rabbits fall more rapidly than the aging rate, after irradiation. An increased excretion of bile pigment succeeded large doses of P^{32} or x-radiation. Utilizing Fe^{59} as an indicator, they established a fall in the total circulating Fe^{59} and in the erythrocyte mass within 4 days after a fatal dose of x-rays. The reticulocytes were early depressed and then recovered after 4 to 8 days. An actual reticulocytosis appeared in 12 days. To compensate for cellular loss, the plasma volume early increased; but in fatal exposures it fell after 4 days. The liver and spleen were enlarged from congestion and hemosiderosis which paralleled the irradiation. In their opinion, several factors contributed to the postirradiation anemia, i.e., loss of erythrocytes from aging with the failure of replacement from the depressed marrow, diversion of erythrocytes from the circulation to the lymph compartment, and increased destruction. Capillary injury contributes to the composite discrepancy.

Allen and Sanderson (1945)[5] added a further potential factor in the pathogenesis of anemia incident to irradiation. They demonstrated an excess of heparin in dogs exposed to 450 r total irradiation. Later, Allen and Jacobson (1947)[6] determined that thrombocytopenia played only a secondary role to the hyperheparinemia in the hemorrhagic manifestions of ionizing radiation. In addition to demonstrating an excess of

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free heparin in the circulating blood of irradiated dogs, they found a closer correlation of this element with the bleeding tendency than of any other factor in the coagulative system. Even when there was a thrombocytopenia, toluidine blue controlled the bleeding without modifying the platelet count. In the presence of hyperheparinemia, vitamin K, ascorbic acid, excesses of calcium and transfusions of whole blood neither prevented nor controlled bleeding.

Florentin and Binder (1949)[7] studied the effect of x-ray irradiation on the myelogram. In animals the sternal marrow disclosed a constant and progressive aplasia. In man, the primary injury is to the young cells of the marrow and not to the circulating cells in the blood stream. Although the myelograms were frequently unsatisfactory, these workers found depression in all elements of the marrow. In 20 patients studied, the marrow showed a rise in the metamyelocytes as the neutrophiles fell from 70 to 23 per cent, on the average. The hematopoietic changes may appear as long as 3 months after the treatment. Dunlap (1942)[8] related the hematopoietic effect to the dosage of x-ray. The marrow components and their peripherally derived blood cells show a constant graduation of sensitivity to irradiation, i.e. lymphoid tissue most sensitive, erythropoietic tissue least sensitive and granulopoietic tissue intermediate. In the recovery from injury, the same order obtains. The phase of injury finds the lymphocytes at their nadir in 3 days, the granulocytes in 6 days and the erythrocytes in the first few weeks. The phase of recovery is marked by relative or absolute lymphocytosis, moderate granulocytopenia and varying degrees of anemia. Abnormal damaged cells are encountered in the peripheral blood. Bizarre immature forms reflect the abnormal regeneration in the marrow.

Of recurring interest has been the observation of an increased incidence of leukemia among radiologists. In 1944, March[9] reported that 8 radiologists had died of leukemia in the preceding 15 years—a rate ten times that for other physicians. Krebs, Rask-Nielsen and Wagner (1930)[10] found lymphomatosis in 3.6 per 1000 x-rayed animals as compared with 0.58 per 1000 controls. Furth and Furth (1936)[11] established myelosis eight times as frequently among x-rayed mice as compared with controls. With graded doses of x-ray Henshaw (1944)[12] was able to produce destructive changes in the blood-forming tissues that were still compatible with survival. In the phase of regeneration, hyperplasia and actual neoplasia of the hematopoietic tissue appeared with or without alteration in the peripheral blood. If true leukemia resulted, the onset was sudden and the peripheral leukocyte count rose rapidly. In this study, the histologic criterion was actual leukemic infiltration of the parenchymal tissues. Twenty-nine and eight tenths percent of the irradiated mice developed leukemia in contrast to 7 percent of the controls. The cell types were indeterminate and undifferentiated.

From the background of clinical and experimental experience, grave hematopoietic injury was anticipated from exposure to the atomic bombing. Many clinical reports have emanated from the studies of the Japanese victims of these experiences. Nausea and vomiting were early experienced. The occurrence of fever and diarrhea the day after the bombing led the Japanese attending physicians to suspect an epidemic of dysentery and to take precautionary steps for its control. Epilation and burns were common. The distance of the exposed from the hypocenter determined the hematopoietic injury. Two thousand meters was essentially the limit of danger from this effect of gamma radiation. Petechiae or frank purpura appeared in 4 to 7 days. In fatal instances, the decline was rapid and death sudden. The platelets were markedly diminished; but capillary injury and infection magnified this fundamental fault. Overwhelming infection and septicemia with diffuse gastro-intestinal ulceration added to the toll of mortality. Warren (1946)[13] cited leukocyte counts as low as 200 per cubic millimeter in the first few days after exposure. LeRoy (1947)[14] indicated that recovery was rare if the leukocytes fell

below 600. As a prognostic detail, the Japanese required that all exposed individuals be placed at bedrest if the leukocyte count were below 1,500. Anemia of varying severity was observed. Total erythrocyte counts of 1,000,000 and lower were recorded. LeRoy encountered patients with a milder, more insidious course in whom the constitutional symptoms were less marked. Mild inflammation of the mucous membranes of the mouth and throat appeared with or without ulceration. These patients showed few petechiae. Even with such an innocuous onset, such patients occasionally progressed to aplasia of the marrow in 2 to 4 months.

The United States Atomic Energy Commission (1950)[15] has stated, "The most sensitive indication of acute or near-acute effects of a fission product, irrespective of whether it is localized in bone or generally distributed, is the reduction in the number of lymphocytes." With the lymphocytopenia Beck and Meissner (1946)[16] remarked cloverleaf and lobed nuclei. At necropsy, all cellular elements of the marrow were decreased. Warren commented on the illusionary appearance of hyperplasia of the marrow that depends upon the engorged sinusoids of an aplastic tissue. All observers have remarked the occurrence of hemorrhage in the lungs, kidneys, gastro-intestinal tract and meninges at necropsy. The spleen is usually shrunken and relatively free of blood. Lipoid depletion of the adrenal cortex obtains.

Experimental studies on the hematopoietic aspect of ionizing radiation have disclosed certain cogent details. Hempelmann, Lisco and Hoffman (1952)[17] found intranuclear vacuolization of the monocytes and red granulation in the cytoplasm of lymphocytes in irradiated mice. In reporting the Bikini experiment Cronkite (1950)[18] felt that, in addition to the factors of thrombocytopenia, hyperheparinemia and increased vascular fragility, activation of the serum fibrinolysin must be considered in explanation of the hemorrhagic features of acute ionizing radiation. Both goats and swine developed purpura and hemorrhages if the exposure were adequate. In swine in the terminal stages in addition to bleeding from every orifice, attendant upon thrombocytopenia and increased capillary fragility, Cronkite encountered bizarre cells and many bacteria in the peripheral blood.

By analogy with the delayed effects of other forms of ionizing radiation, the increased incidence of leukemia among survivors of the atomic bombing of Hiroshima and Nagasaki is not unexpected. Warren's report of an isolated instance of monocytic leukemia in 1946 probably does not represent a radiation casualty from this cause. Folley, Borges and Yamawaki (1952)[19] found that 78 percent of the deaths from leukemia in the two ill-fated cities occurred among inhabitants within 2000 meters of the hypocenter, although only 20 percent of the population was so distributed. In the remainder of the population (80 percent) 22 percent occurred. Yamaki (1954)[20] analyzed the statistical distribution of leukemia. In the period 1930 to 1934, the deaths from leukemia in the city of Hiroshima showed no deviation from the Hiroshima Perfecture or the country at large. The period 1947 to 1950 showed a marked increase in acute and subacute leukemia and chronic myelogenous leukemia. Up to January 1, 1954 Moloney[21] collected 92 instances of leukemia among survivors of the bombings of Hiroshima and Nagasaki. The peak was reached in 1951 with a decline in 1953. The rates were especially high among those incurring severe acute radiation injury within the 2000 meter critical radius of the hypocenter. In three years after the bombing, thirteen children had died of leukemia.[20] Gamma radiation of high energy is apparently the chief leukemogenic agent (Lange, Moloney, and Yamaki, 1954).[22] Some question of a sharing of the responsibility by neutrons has been raised (Moloney, 1955). Obviously in the situation under discussion, a single massive dose of ionizing irradiation has sufficed to induce major hematopoietic derangements. Repeated smaller doses may be equally or more dangerous in this respect.

Moloney and Lange (1954)[23] and Moloney (1955) have attempted to anticipate the

frank clinical picture of post-irradiation leukemia by careful studies of the hemogram. Early the peripheral blood may disclose a leukocytosis with relative lymphocytopenia and granulocytosis. Immature cells of myeloid origin, neutrophilic metamyelocytes, myelocytes, promyelocytes and myeloblasts may appear. Particularly significant, in their opinion, is the basophilia. In these cells the nuclei are occasionally misshapen. Singularly, the platelets are increased. In addition to poikilocytosis and anisocytosis there may be a rare nucleated red cell. The marrow is not diagnostic but active leukopoiesis has been noted. The white cell alkaline phosphatase is reduced under these circumstances.

The protective mechanisms against radiation injury have been carefully analyzed by Patt (1953).[24] Admittedly, the problem of the reaction of vital living tissue to such forces is complex. While in the past, the phenomena in the irradiation of water have been extrapolated to protoplasm with the establishment of a baseline of approach, many biologic factors are involved in the radiochemical reaction in living tissue. The function of the proteins in neutralizing indirect effects, such as enzyme inhibition for example, immediately presents itself. Dowdy, Bennett and Chastain (1950)[25] demonstrated that brief periods of anoxic anoxia (5 percent oxygen) protected animals in some measure against total body x-ray irradiation. Sodium cyanide was not protective. Hence it may be assumed that the vital physiochemical change resulting in fatality in the control animals upon irradiation depends upon the availability of oxygen. The injection of bone marrow and intraperitoneal transplants of the same in mice protect the recipient from lethal doses of x-radiation (Lorenz and Congdon, 1954).[26] Similar results from the injection of marrow had been reported in guinea pigs by Lorenz, Uphoff, Reid and Shelton (1951).[27] If administered before irradiation cysteine protects experimental animals from radiation injury (Goldie, Tarleton and Hahn, 1951[28]; Brues and Patt, 1953[29]). By raising the threshold, lethability, lymphocytopenia, granulocytopenia, splenic involution, epilation and lenticular opacity may be averted when cysteine is given before the irradiation. Brues and Patt hypothesized that cysteine may act by diminishing the availability of oxygen. The observations of Jacobson and his associates (1950)[30] on lead shielding of the spleen are most significant in this connection. In the unprotected mouse, x-ray irradiation (1025 r) was succeeded by anemia, leukopenia, thrombocytopenia and reticulocytopenia. All control mice died before the thirteenth day. When the spleen was protected in a lead chamber, 42 percent lived beyond 28 days. Under this protection lymphoid tissue was never completely depleted. After the 7th or 8th day the lymphoid tissue was essentially normal and the animals showed erythropoiesis and granulocytopoiesis. Similarly, the marrow in the protected mouse never showed the degree of depletion of the control animal. In fact, the marrow of the protected animal was completely normal by the 7th or 8th day and hyperplastic thereafter. Extramedullary blood formation was the rule. With the prompt recovery of the histologic integrity of the marrow and lymphoid tissue there was no anemia and but slight transient leukopenia and thrombocytopenia.

Miller, Hammond, and Tompkins (1951)[31] made certain basic observations on the role of infection in radiation injury. In mice receiving 600 r, 113 of 288 gave positive cultures in the heart's blood or spleen. Of 595 mice given 450 r, 152 had positive cultures. Septicemia of enteric origin was therefore overwhelmingly the greatest cause of death from irradiation injury.

Epitomizing this broad survey of the hematopoietic effects of ionizing radiation injury, the following points should be emphasized:

1. The blood-forming tissues are vulnerable to irradiation in the following order:

Lymphoid
Granulopoietic
Erythropoietic

Hypoplasia and aplasia of the lymphoid tissue and of the bone marrow result from this injury.

2. The impairment of erythropoiesis, together with other factors, leads to anemia. Aplastic anemia is the most serious form. Depression of leukopoiesis with neutropenia seriously compromises the normal defenses of the host. Ludwig's angina, necrosis of mucous membranes and septicemia result. Thrombocytopenia, with other factors, predisposes to hemorrhage and purpura.

3. Irradiation acts as a leukemogenic agent. Single massive exposures may exert this effect. Multiple smaller doses may be even more dangerous.

4. The exact manner of action of ionizing irradiation in inducing these effects is not clearly understood.

5. Presently, certain protective measures, viz. reduced oxygen, cysteine and marrow administration, and splenic shielding, have been proved to be effective when applied *before* the exposure of experimental animals.

6. Prophylactic procedures in potential industrial, laboratory and clinical exposures assume an increasing importance with the extension of the use of various forms of ionizing radiation in industry, medicine and science. Supplementing the available protective devices and careful monitoring, workers in these areas should have periodic studies of the blood. Progressive decline in the total leukocyte or lymphocyte count or both should be met by withdrawal from the exposure until the normal hemogram is restored. Arbitrarily limits of a total leukocyte count of 5,000 and of 1,500 lymphocytes per cubic millimeter have been set for the interruption of occupation. The trend is more important than the isolated count.[32]

7. Rest, symptomatic, and expectant measures, such as infusions and transfusions, are the current limitations of therapy when actual irradiation injury has occurred. The routine use of antimicrobial agents is advised in the light of the significant frequence of infections and septicemia complicating irradiation injury. Toluidine blue and protamine have a theoretic place in combatting the hyperheparinemia.

Addendum

Recently Cronkite and his associates reported the response of man to fallout radiation on the Marshall Islands. (Journ. A.M.A. *159:* (Oct. 1), 1955, 430.) This accidental exposure of the inhabitants of several atolls represented the wide scatter of pulverized coral, coated with radioactive fission products, by the wind. Of necessity, general body irradiation through skin contamination resulted. The dosage was calculated at 14 to 175 r. To this factor, an indeterminate increment occurred by ingestion and inhalation. The hematopoietic results of these exposures closely paralleled the earlier experiences. The lymphocytopenia was the most significant detail. Total lymphocyte counts as low as 700 to 1000 per cubic millimeter were recorded. Younger people reacted more promptly than older. The neutrophiles numbered 70 to 80 percent of the normal controls in the second week and fluctuated from 50 to 75 percent of the control level for a continued period. Intercurrent respiratory infections did not alter the picture nor conversely was their course complicated. The platelets fell to 60 per cent of the control (female) by the tenth day; but in the fourth week a sharp decline to 30 per cent was recorded. By the fifth or sixth week the platelets had risen to the level recorded the tenth day. Secondary declines were observed in the seventh and eighth weeks. Menorrhagia was remarked in two women with platelets of 130,000 to 150,000. A year later the neutrophiles of the studied subjects were normal; but the lymphocytes, monocytes, eosinophiles and platelets were still subnormal.

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Ten Years of Atomic Medicine*

By
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IF MAN had not been born with ten fingers we probably would not pay reverence to the decimal system. But being as we are, it is natural at the end of ten years to see where we stand with regard to atomic medicine.

On the one hand, you as military surgeons have been concerned with the antipersonnel effects of atomic weapons and have watched with apprehension their growth from nominal bombs that obliterated Hiroshima and much of Nagasaki to the fusion explosion that made a crater into which fourteen Pentagons could be neatly tucked and rendered temporarily uninhabitable an area of thousands of square miles. On the other hand, you are doctors as well as military men and you have followed with equal care and with lighter hearts the advances made in the peaceful applications of atomic energy to our field of effort. The Geneva Conference on the Peaceful Uses of Atomic Energy inspired by President Eisenhower proved a fitting summary of the progress of the first ten years of the atomic age. There scientists from 72 nations took stock of current knowledge and exchanged views on our hopes for the immediate future. In these ten years what has happened?

1. The acute radiation syndrome has been recognized and studied, its pathogenesis more clearly understood.

2. Knowledge of the field has been disseminated from the bare handful of interested workers in 1946 to the thousands who are now working in every continent, and nearly every country.

3. Radiosotopes have become changed from a rarity and scientific curiosity available only to a few to a widely available tool that few can afford to be without.

4. The value of radioisotopes as research tools has been clearly and firmly established.

5. The therapeutic value of several of the radioactive isotopes has been explored and that of others is underway.

6. The whole field of genetics and population studies has been given a great impetus and for the first time sound information in mammalian genetics is being obtained on a large scale.

7. Test explosions have provided us with the means of mass study of the atmosphere and air motions that would have been possible no other way and meteorology has for the first time the means for large scale observation.

8. The value of atomic reactors in the field of medicine has been tentatively explored and is apparently so great as to warrant the establishment of medical reactors in a number of localities.

The acute radiation syndrome, first vaguely known from a few drastic therapeutic experiments in X-ray radiation of lymphoma and leukemia, is now fairly clearly understood, thanks to studies at Hiroshima and Nagasaki, the very few accidental exposures that occurred in the work of the Manhattan project of the Atomic Energy Commission, and a number of animal experiments. Overwhelming doses of total body radiation, 5000 r or more result in acute death with cessation of many bodily functions probably chiefly due to the inhibition of key intracellular reactions. With doses between this range and the lower limit of lethal (the lethal dose for 50% of a human population is approximately 400 r), the failure of one or another key physiologic system can be clearly recognized. Gastrointestinal disturbances and those of the hematopoietic system, particularly in the

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leukocytic series, predominate. Below 100 r it is rare for symptoms to appear or to be significant. However, some evidence of central nervous system damage, particularly in the finer discriminatory functions, seems to occur.

The lowered white blood cell count together with some degree of damage to the reticulo-endothelial system results in lowered resistence to infection both external and autogenous. These manifestations can frequently be ameliorated by the use of antibiotics. A later manifestation is the development of hemorrhagic diathesis primarily related to a diminution in blood platelets with manifold symptomatology depending on the localization of the hemorrhages that occur. Anemia may finally appear, usually as a part of a pancytopenia, in cases that survived for six weeks or longer. In the majority of surviving cases recovery is relatively complete although in a few instances residual hematopoietic and gonadal changes may persist. Careful study of the survivors in Japan, and the more chronic animal experiments led to further information in the understanding of these complex symptoms.

With the ready availability of radioactive isotopes for medical and biological purposes from Oak Ridge, from Harwell in the United Kingdom, from Chalk River in Canada, and with their availability behind the Iron Curtain from sources located there, throughout the world there has been an extensive utilization of these isotopes for therapy and for research. In general, the most important isotopes from the standpoint of internal application, are radioactive phosphorus, radioactive iodine, and radioactive gold; for external sources of application radioactive cobalt, radioactive phosphorus, and radioactive strontium have been most commonly used and are of established value. A number of other isotopes are under investigation. Undoubtedly it will be some time before we have clear understanding of the potential therapeutic applications of this new form of energy. It was of interest to note at the Geneva Conference this summer that the Russians were making much more extensive use of radioactive elements externally than were we. P^{32} was used, for example, as an external source in the therapy of a number of cutaneous neoplasms.

Radioactive cobalt has very largely displaced radium for use as an external source and is significant competition with thera peutic X-ray apparatus. At present the de mand appreciably outruns the supply but there is hope for improvement in the supply of radioactive cobalt in the not too distant future.

Radioactive isotopes have taken firm foothold as essential tools of research. Providing a clear and specific tagging of atoms as they do, they have enabled us greatly to advance our knowledge of intermediary metabolism and to develop new techniques for understanding enzymatic reactions.

Since radioactivity can be detected in very minute amounts by the types of instrumentation now available, and since these amounts can be quantitated usually within 10%, the tracer technique affords a tool that on the one hand will not alter the character of a reaction because of the low energy of the isotope but yet will make it easy to follow.

Because of the incidental fall-out of radioactive material from nuclear explosions and the potential exposures of large populations to very small amounts of ionizing radiation as atomic energy becomes more a part of our daily lives there has been much interest in the genetic aspects of radiation. It has long been clearly established that large doses of radiation will induce mutations in the fruit fly. Because data from the fruit fly experiments indicate a linear proportionality of mutation to total accumulated doses of radiation, there has been a tendency to extend this to mammals. This rests as yet on somewhat inadequate evidence. That mutations can be produced is unquestionable—that most mutations produced in humans tend to be deleterious rather than helpful is established. The evaluation of risk cannot be made with the data now available. Long range experiments with mammals are essential to supplement those now being carried out both here and abroad. It is hoped that

sufficient preliminary data will have been accumulated by next spring to add much to our present knowledge. Suffice it to say on the one hand the radiation levels at which humans may be exposed should be kept as low as possible and on the other hand, no significant change has been reported in the children of Hiroshima and Nagasaki survivors.

Man, although somewhat independent of environment, is still largely at the mercy of the elements. A drop of 20° centigrade in the average temperature of the earth would bring back the ice age. A comparable increase would place palm trees at the pole. The carefully evaluated fission products of atomic explosions have permitted careful study of major air movements and of local behavior of significant atmospheric masses. Thus far, this knowledge is too new, too fragmentary to be of major value to meteorologists whose science is still in its infancy as their efforts towards the predictions of the courses of Hazel, Diane, and Ione have demonstrated.

The use of the atomic reactor as a means of providing neutron therapy is new and has been but lately explored. Some promising results particularly when combined with the boron-neutron capture technique have proved of interest. Not only is the atomic reactor a useful source of neutrons but in addition it can provide shortlived isotopes for investigation which now are available only at the major laboratories of the Atomic Energy Commission. As more and more nuclear reactors become available for full- or part-time use even more rapid progress in medical research will become possible.

The Federal Civil Defense Administration Medical Stockpile*

By

JOHN M. WHITNEY, M.D.†

CONTRARY to certain reports and articles published more recently, the Federal Government *has* made considerable progress in the preparation for an enemy-created disaster as far as civil defense activity is concerned.

While there has been considerable work done in Warning, Communications and Engineering programs, etc., I would like to speak specifically on what we at the Federal Civil Defense Administration have done pertaining to the field of medicine. We believe we have accomplished a great deal toward assuring that an adequate quantity of medical supplies and equipment will be available from Federal stocks so that the physician, the nurse and the first-aid worker, in time of disaster, can accomplish their missions.

When we attain present objectives we expect to have dispersed in strategic spots throughout the United States some $411,000,000 worth of medical supplies and equipment. Since the program started in 1952, we have had delivered to our warehouses, or there is on the way, approximately 133 million dollars worth or about ⅓ of this total value in medical items. This year we plan to spend another 32 million toward this goal.

To describe this goal in terms of casualty care, we hope to eventually place in our warehouses enough supplies to treat 5 million surviving casualties for a period of 3 weeks. At the present time, except for the number of improvised hospitals required, we have enough basic back-up medical supplies in stockpile for 2½ million causalties for a three-weeks' period. By this time next year the number will be 3½ million for three weeks. Examples of some of these supplies are as follows:

7,250,000 Special Burn Dressings
9,000,000 Doses of Penicillin
33,000,000 Capsules of Broad Spectrum Antibiotics
175,000 Litters
1,500,000 Blood Derivatives (Plasma & Serum Albumin)
3,660,000 Plasma Volume Expanders (Dextran & PVP)
2,000,000 Whole Blood Collecting and Transfusion Sets
132,000 Radiological Monitoring Instruments
25,262,500 Doses of Vaccines and Antitoxins for Biological Warfare Defense and Communicable Disease control. . . .
And large quantities of some 400 items including sanitation supplies, chemical warfare defense supplies, and improvised hospitals.

As I said, we are dispersing these supplies throughout the United States and in some of our territories. We have 32 storage places at this time, large and small, some of which contain unitized quantities of the items to supply early replenishment for first-aid stations and hospitals; other warehouses contain large quantities of bulk back-up supplies. These storage places are located in small urban communities, but within 4 hours of our major critical target areas. We are developing this year a system of so-called "fringe" warehousing wherein we will locate unitized supplies in numerous small depots or "drops" within a radius of 30 to 100 miles around critical target areas. The space in

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these smaller warehouses will range from 8,000 to 20,000 square feet. The total number of warehouses will be increased to about 47 by the end of fiscal year 1956. The eventual number will approach 100. Plans are being made to keep them out of the expected radioactive fallout areas as far as possible.

Although some of these storage areas will undoubtedly be subjected to radioactive fallout, there would be little permanent damage, and most supplies could be used in a few days to a week or two. One of the reasons for this is that the FCDA supplies are packaged for the most part in accordance with the Armed Services Specifications for Export Pack—and as many of you know, this is a good long-term storage pack.

As a matter of fact the Armed Services Specifications are followed wherever possible in the procurement of the items themselves, and all medical procurement is conducted for FCDA by the Armed Services Medical Procurement Agency.

The shelf life of the bulk of our items is indefinite, but we have a few problems in the instance of dated items such as the antibiotics. We are attempting to rotate these with other governmental agencies and with the manufacturers, but are not meeting with much success. The size of the stockpile of almost any deteriorative item necessary for wartime operation cannot easily be absorbed through peacetime usage.

We must have a number of sterile items on hand, such as intravenous injections and certain dressings. These must be closely watched and tested periodically to assure that they are always safe for use.

It is obvious we will require a vast hospital program since such a large number of our hospital beds are in critical target cities and will be lost. We have calculated we will need some six-thousand 200-bed Improvised Hospitals to care for the great casualty load anticipated in an all-out attack, and to replace those hospitals knocked out. So far, we have procured for Federal Stockpile some 830 of these hospitals. Some of you may have seen the display hospital exhibited this year at the American Medical Association Convention in Atlantic City and at last year's American Hospital Association Convention in Chicago. While we have not progressed as far in this area as in others, all efforts are being made by FCDA to secure larger appropriations for this phase of the program. To stimulate interest in this program the Health Office has developed a plan for putting out on loan to critical target states or cities, hospitals from the Federal stockpile for exhibition and training purposes. Under this plan 26 of these complete hospital units will go out this month for scheduled stays at cities on a rotating basis.

I have not said anything about some of the fine work that certain of the States are doing to accumulate supplies for a civil defense emergency. So far under the Federal Contributions Program, some 40 States have purchased 26 million dollars worth of medical supplies and equipment of which the Federal Government has borne half the cost. It is our planning that the State and local communities should have on hand enough supplies for the first few hours after a disaster or enough to last until the Federal backup supplies can be brought in.

I could, of course, go into great detail on almost any phase of this vast medical program, but that is not possible here. Therefore, I cordially invite all of you to get further acquainted with our program by keeping in touch with us professionally. I am sure many of you could be of great assistance to us in our planning for future civil defense medical activities.

Medicinal Supplies for Mass Casualties from a Pharmaceutical Producer's Viewpoint*

By
RAYMOND M. RICE, M.D.†

MEDICAL opinion varies widely concerning essential therapeutic agents needed in treating mass casualties and, consequently, the list of drugs is long. Not every type of emergency can be anticipated by having the prescribed medicinal product available at the right place and time but there is a smaller group of drugs, used almost universally, which through careful planning can be put into use with little delay. The more important of these are apparent to any physician—agents for controlling pain, combating shock, treatment of infection and, of course, supplies to care for traumatic injury.

In preparing for possible attack with adequate therapy two uncertainties seem to complicate planning. Where and when will we be struck? The question of "where" can, to a degree, be handled by lavish stockpiling at the most obvious points of attack. The second uncertainty, the question of "when" —is of greater interest to an industry constantly concerned with drug stability.

Through General Wood and Dr. Schilling it has been possible to review incomplete lists of medical items which are of interest as stockpile materials to the medical service of the Army. Fortunately many of these can be held indefinitely under proper storage conditions without deterioration but some of the most important must carry a dating beyond which their effectiveness is lessened.

Antibiotics while relatively stable eventually lose potency. Penicillin G tablets carry a five year dating and the parenteral preparations are not intended for use more than three or four years after formulation. Streptomycin in dry form has a four year dating; Tetracycline two years; and Erythromycin three years. Tetanus Antitoxin has an expiration date of three years after its release by the producer.

It is interesting to read remarks made by Mr. Val Peterson, Administrator of the Federal Civil Defense Administration during hearings on an appropriation bill a few months ago. Deterioration of stockpiled antibiotics seemed to be a matter of real concern as the materials on hand aged and came nearer to their expiration date. Methods of rotating these stocks had been considered but up to that time no method had been found which would provide for replacement with fresh materials and consumption of the older stock in an area where antibiotic therapy was being actively practiced. It would appear that the government may eventually be purchasing new stocks for day to day administration, while stockpiled antibiotics and biological products remain on hand to a useless old age.

With some conception of the intricate bigness of governmental operations, it is realized that the easiest procedure is to give away outdated stocks and purchase new, but this seems a needless waste. To one in the pharmaceutical industry, sudden disposition through gift or by sale of large quantities of drugs by government is undesirable because of the effect upon normal production and marketing of these materials. Surely with substantial day in and day out use of these less stable items there must be a way to rotate stockpiled antibiotics and biologicals to retain fresh emergency stocks without substantial loss.

As a major producer of Insulin, Eli Lilly

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and Company must be responsible for a continuous supply of this essential agent for all diabetic users. During the last war disruption of normal meatpacking operations resulted in a critical shortage of pancreas glands, the basic material from which Insulin is prepared. It was fortunate that substantial reserve supplies had been retained to meet just such an emergency. At present Insulin for twenty-four months of normal use is stockpiled, at all times, but it is not allowed to "out date." As older lots are released into trade channels they are replaced with fresh material and the two year supply is maintained without loss. As an additional precaution this reserve stock is not all stored in one place.

It is difficult to visualize a supply of emergency items which would do more than carry the severely injured through the early period of treatment. Thereafter new supplies must be made available. What stocks does the manufacturer have on hand and how rapidly can production be increased? Speaking for a single producer the following may help to answer the questions.

Normally, stocks of penicillin products ready for shipment amount to eight or nine months of normal civilian use. It is assumed that most of the nine or ten basic antibiotic manufacturers have comparable reserves. In addition, the wholesale druggists and the retail pharmacists countrywide have on their shelves a quantity for approximately forty-five days of normal use. In emergency, much of this could be placed in disaster areas within a few days.

Emergency production of anti-infectives would proceed at a slower rate for organisms which produce antibiotics do not work on a forced schedule. It takes three to four months to produce penicillin from initial fermentation in massive tanks to its final oral or parenteral form. There is substantial spare production capacity for antibiotics in the pharmaceutical industry but it would take time to put it in operation.

Emergency production of antitoxin and toxoids presents a darker picture with the time-consuming biological methods which must be followed. Tetanus Antitoxin, produced by stimulating formation of antibodies in the blood of horses, cannot be made ready for human use in less than four to six months. Tetanus Toxoid requires six months for final processing.

In conclusion, it seems apparent that stockpiling of medicinal products is an essential part of planning for emergency and that very substantial quantities must be kept on hand. Since some of the most important therapeutic agents deteriorate with age, a plan for orderly rotation of stocks should be devised so that stockpiled items are fresh and aging materials are released for useful application while still of full potency. Medicinal items so released should not be placed in normal commercial channels but might best be used in areas where day to day practice of government medicine includes antibiotic and biological therapy.

MEDICAL EFFECTS OF NUCLEAR WARFARE*

Introduction to Problems

By

MAJOR GENERAL JAMES P. COONEY, MC, *U. S. Army*
Deputy Surgeon General of the Army

THE objective of the next few days is to consider the medical problems arising from the utilization of nuclear weapons. During this meeting the various speakers will cover material essential for an understanding of the problems. Certainly, all of the answers are not available but we hope that accurate presentation will provide a more complete insight into the many difficulties. In order to appreciate mass destructive and hence mass casualty producing weapons, it is necessary to consider the entire picture in a realistic setting. Solutions designed for the management of truly large numbers of patients may be at variance with the accepted peacetime, and the usual wartime practices. The impact of nuclear weapons on the medical system as we know it in the Armed Forces today may render obsolete the established methods of organization, medical evacuation, and professional policies. The sheer physical stress involved in coping with human suffering and physical damage on such a scale will surely tax available command and medical facilities to the utmost.

Historically the first nuclear weapon was detonated at Alamogordo, New Mexico, ten years ago, July (1945). As you all know within a few days nuclear weapons were actually used by the United States Armed Forces over the Japanese empire. In the years that followed, despite newspaper articles, books and many discussions about the absolute weapon, or the weapon to end all wars, our military and national planners including medical authorities felt that a relatively sound solution was available. This solution was based on the assumption of limited nuclear weapons and limited targets. It was determined with reasonable justification that minimal modifications of World War II concepts would be adequate. Medical plans included rapid mobilization of nearby facilities and patient dispersal to non-affected medical centers relatively close to the target area. It was clearly recognized that the casualty load would be considerable, but it was reasoned that limited stockpiling of supplies and organization of disaster teams could be the answer to the problem. However, in his now famous speech before the United Nations in December 1953, President Eisenhower upset a good deal of this complacency when he revealed that a great deal of progress had been made in the production of weapons. He emphasized that weapons were now not only many times as powerful as those used over Japan but also that we are now in the age of nuclear plenty. It was, or should have been obvious to all that, to think of the 20 kiloton weapon over the occasional target, was not only completely unrealistic but foolhardy. For the first time since the Revolutionary War an enemy has the ability to threaten our nation's existence. It seems only reasonable to assume that, if and when nuclear weapons are used, they will represent blue chips in the political-military plans for world domination. Medical responsibilities in the event of nuclear war is the theme of our discussion for the next several days.

In the event of multiple nuclear attacks and the simultaneous production of mass casualties the medical problems will certainly be affected by the gross disparity between the size of the medical load and available

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medical manpower. Considerations that do not include this assumption appear unrealistic, and will be found lacking if the actual events ever occur. In the past ten years a great deal of effort has been spent in trying to understand and teach various detailed effects of nuclear weapons. Some of the effort has involved discussions of detailed physics and mathematics relating to the bomb and the microseconds following the detonation. This approach has led to a preoccupation with details that will not help us as medical people to solve the casualty problems. In addition, the preoccupation with these details has resulted in the creation of an aura of mystery around the weapon that has prevented the average individual from understanding the things that are essential to him and to his neighbor if they are to survive. There is no one to blame for these digressions, but it is time to end this interlude and attack the problem directly by ignoring the frills of complicated equations and formulae. How many of us understand the physics and chemistry involved in the explosion of a high explosive shell or, for that matter, the propulsion of a rifle bullet from a gun barrel to target?

We are directly concerned with the effects of nuclear explosions insofar as they will allow us to understand and predict the clinical problems that we will be required to cope with. We need to know the types of injuries that will result and something of the relative number of casualties that will require hospitalization. A workable knowledge of these facts is essential if we are to make a realistic estimate of professional requirements and determine what methods of treatment are to be recommended. These basic professional decisions are the foundation of the management of mass casualties. Only when professional decisions are made as to the type of treatment to be performed by medical service personnel, can we hope to establish logistic and personnel requirements. Medical organization to facilitate maximum utilization of all resources is a natural sequel.

The development of very high yield weapons of the thermonuclear type has necessitated a reorientation in our thinking. The large area fallout problem has added new difficulties and, unlike the air burst weapons over Japan, has the capability of creating large numbers of radiation injuries. It is important to remember, however, that the fallout involving many square miles can only follow a weapon which initially has the capability of creating enormous numbers of blast injuries and burns. A thermonuclear explosion near a target city involves a tremendous initial emergency medical problem as well as a delayed effect due to radiation injury. As always the emergency problem must be attacked first. It may be that the most important result of the fallout or residual radiation hazard will be the interdicting effect on recovery operations.

Psychologically much has been written on the effects of the weapon and how it will create "panic" and complete disorder in the surviving population. In general, two elements must be present for panic to occur. These are, first, a threat of imminent danger and second, an avenue of escape. Inasmuch as the threat was not present in the Japanese atomic attack and the cities were unwarned, the sudden overwhelming catastrophe left a stunned, apathetic populace. However, with the knowledge by the public at large that the enemy has a devastating capability, the elements leading to panic will be present and panic is likely to occur unless sound planning is forthcoming, resulting in public confidence that warning instructions, if obeyed, will be the only possibility of individual salvation. As an important part in combating adverse psychological reactions and preventing panic, we must have an effective, organized medical effort directed to the care of survivors immediately after the attack. There is no more direct way that we can help to restore order and assist the commander in regaining operational control.

There are many controversial subjects involved in the papers to be presented during this meeting. Obviously we do not have all of the answers to the many and varied tasks that will surely confront us, but I am certain

that if we attack the problems openly and directly, we can design workable, if not happy, solutions. I am certain that these solutions can be found but I also know that they evolve only after a great deal of foresight, thought, discussion, realistic planning and hard work. Training on a national scale for all health organizations is essential. A notable example of national training is the *Medical Education for National Defense Program*. This is a joint Department of Defense, Medical School effort and is directed to medical students as part of their educational curriculum. A great deal more needs to be done along similar lines with medical and allied health groups.

The remainder of this afternoon will be devoted to a discussion of the effects of nuclear weapons of particular importance to a medical group. The information given is basic to an appreciation of the professional problems we can expect and, when possible, current applications to the medical problem will be indicated. In addition, an understanding of these effects will allow us, through prior planning, to reduce the number of injuries incurred in the target area. Protective measures prior to detonation and appropriate evasive action immediately following will significantly reduce the number of injuries and therefore the size of the medical problem.

The President's message of December 1953, referred to above, had medical implications which are still neither widely enough nor well enough understood. In essence, that message was the public announcement of the dawn of the megaton era and the end of the kiloton era. The jump from kilotons (Hiroshima, Nagasaki) to megatons was fully as great a stride as the previous jump from conventional explosives to kilotons, and the associated medical problems have increased accordingly.

If these present sessions are your first professional contact with the casualty problem created by megaton bombs, then I am sure that your initial reaction will be one of hopelessness. The facts and numbers are so overwhelming that, at first, any attempt at defense seems futile. Nevertheless, if one holds his mind to the problem long enough, certain simplifying ideas will become discernible. For the population under attack it becomes evident that some possible courses of action definitely make the problem worse and therefore should be avoided. This leaves other lines of action to be considered, and this simple elimination method is, I believe, the beginning of wisdom in the matter. If history is any teacher, it should be possible to start in this fashion and work out a distribution of resources such that no single attack could be mortal to our Armed Forces. It is precisely this type of rock-bottom planning for the worst which will do the most to deter a sneak attack—a thermonuclear Pearl Harbor. In the matter of this planning the military medical community bears a heavy responsibility.

Phenomena Associated with Nuclear Detonations*

By

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AT THIS time of year the triple-threat man of football is much in the public eye, and so we may be pardoned for referring to a nuclear weapon as a quadruple-threat, something beyond the fondest dream of any football coach. Like the football man, the relative importance of the four threats can vary widely. In a high air burst, blast may be emphasized at the expense of thermal radiation, ionizing radiation, and radioactive fallout. A low-level or contact detonation, on the other hand, may be a highly contaminating event, with blast substantially reduced.

Time does not permit a detailed discussion of the variations possible with different types of weapons and modes of detonation. With a clear understanding of the basic phenomena involved variations can be readily appreciated. For simplicity we will first consider a high air burst where "high" is a vague term whose meaning depends upon the size of detonation. Specifically, for present purposes a high detonation is one such that the incandescent mass or fireball does not touch the ground.

Before detonation the weapon is a relatively small mass of fissionable material, mildly radioactive, but with very little penetrating radiation capable of escaping from the weapon case. Detonation is not a burning, as is the case with chemical explosives; the assembly of masses of subcritical size into a single mass exceeding critical size is all that is required. Assembly must, of course, be extremely rapid, so that as much energy as possible is released before the nuclear reaction is terminated by self-destruction.

In a few millionths of a second all of the energy released by the nuclear reactions is concentrated in the relatively small mass of the device itself. It is convenient in discussing bomb effects to refer to the nominal or 20 KT weapon, which releases energy equal to that obtained from the detonation of 20,000 tons of TNT. Weapons of other sizes can be evaluated by scaling up or down from the nominal bomb.

In a nominal weapon the explosion is equivalent to the energy released by the instantaneous burning of some 7,000 tons of coal. With this amount of energy concentrated in a relatively small volume, the temperature rises to fantastic levels, measured in millions of degrees. At these temperatures all of the bomb is in the gaseous state and under pressures probably of millions of pounds per square inch. This pressure attempts to relieve itself by outward expansion, and so an essentially spherical pressure wave starts to move outward from the incandescent mass. Initially the pressure wave has a considerable thickness but the later portions of the wave move through air heated by the compression of the earlier portions. Since the velocity of propagation is greater at high temperatures, the latter portions of the pressure wave will catch up with the earlier portions to produce a very abrupt change in pressure known as the shock front.

In the early stages the pressures are so high that the shock front has the rigidity of a solid body, and since it moves outward at a speed of about 15,000 feet per second its destructive effects are enormous. The shock front can be identified in many photographs as a dark line on the surface of the water or the earth.

Shock front pressures decrease as the

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front moves outward and the velocity drops to that for normal sound waves, about 1000 feet per second. Thus for most distances the shock front will travel about one mile in every five seconds. It must be emphasized that the shock front is not the outward mass movement of air, as a wind, but rather the movement of a relatively thin high pressure spherical wave.

Although the blast-wave pressure decreases with distance, it tends to be intensified and maintained by reflection from the earth's surface. The expanding blast wave will eventually intersect the surface of the earth, where some energy will be absorbed and some will be reflected. The reflected wave will move through air previously heated by the compression of the original wave. The reflected wave will therefore catch up with the original wave and reinforce it. The combined waves form the Mach stem in which shock front pressures may be several times those in the original shock front. Eventually, the Mach stem disappears and the blast pressures decrease to harmless levels. The duration of the blast wave is such as to be most effective against large structures. A more serious personnel hazard arises from secondary missiles, debris projected with very high velocities by the blast wave.

We return now to consider the incandescent fireball, still relatively small, at a temperature of some millions of degrees. The phenomena taking place here are exceedingly complex but fortunately need not be described in detail for a general understanding of events. Like any hot body, the fireball will radiate energy, and because of its enormous temperature the maximum energy will be radiated at short wavelengths. Our sun has a surface temperature of about 6,000° K and emits its maximum energy in the green region of the visible spectrum. The sun serves as a useful standard for measuring the brilliance of the fireball which may be 100 suns or more. In the early stages the fireball emits maximum energy in the X-ray region. The X-rays thus produced are indistinguishable from the gamma radiation, to be discussed later.

Large amounts of ultraviolet radiation are also emitted by the fireball, but ultraviolet is so readily absorbed that no appreciable amount escapes to distances where man might survive blast. No cases of ultraviolet conjunctivitis were reported in the Japanese survivors.

All radiation of visible wavelengths and longer may be loosely called thermal radiation because these are the spectral regions responsible for human flash burns and the multiple primary fires. The fireball expands rapidly, the nominal bomb reaching its maximum radius of 450 feet in about one second. Energy is lost by radiation and after 10 seconds the nominal fireball is barely luminous.

As the fireball expands it also rises, since it consists essentially of a high-temperature, low-density gas. The behavior is similar to that of the old-fashioned hot-air balloon, except that here the density differences are so great that the velocity of rise may reach 300 feet per second.

Throughout the cooling period the fireball loses energy by radiation, all wavelengths being propagated outward with the velocity of light. The rate at which energy is received at a point on the earth's surface decreases rapidly with time, because the fireball is cooling and the distance is increasing. An appreciable fraction of the energy may be received as late as 10 seconds after the first radiation is received, and this spread makes prompt evasive action worthwhile. If effective shelter can be reached in a matter of seconds after the detonation an appreciable reduction in thermal effects can be expected. Very thin layers of opaque, non-combustible materials are sufficient to shield against thermal radiation, although they may be hopelessly inadequate against blast and more penetrating radiations.

It is very difficult to give radii for thermal effects because atmospheric absorption varies considerably from clear to cloudy weather. On a clear day moderate skin

burns can be expected 2 miles from a nominal detonation and fires will be started out to three-quarters of a mile on a cloudy day. Some of the fires will be blown out by the blast wind, a gust that follows the blast wave, but many will survive the wind, to later merge and grow into a massive fire storm.

Before returning to a discussion of the rising fireball it will be well to consider the more penetrating radiation released at the instant of detonation, the so-called "prompt" radiation. In a fission type weapon each energy releasing reaction is of the type

$$\text{neutron} + \begin{matrix}\text{uranium}\\ \text{plutonium}\end{matrix} = 2 \text{ fission products} + \text{neutrons} + \text{gamma radiation}$$

Some of the neutrons are absorbed by other nuclei to maintain the chain reaction, but many escape from the fireball to make up, along with gamma rays, the prompt, penetrating radiation. This flash of prompt radiation lasts only for a few millionths of a second. Neutrons are particles that move outward with a wide range of velocities. They constitute a hazard out to about one-half mile and since they all arrive in about one second, evasive action will avail little. After one second all the neutrons have been captured by nuclei and are no longer a direct hazard.

Neutrons are very effective in inducing nuclear reactions and many of the captured neutrons will produce radioactive isotopes from stable nuclei. Thus a detonation over sea water will convert some of the normally stable sodium to radioactive sodium. Escape neutrons over land will produce radioactive isotopes depending on the composition of the earth. In general, the activity induced by neutrons is only a fraction of that coming from the fission products but it must be considered in assessing the overall hazard.

Gamma radiation arises from the nuclear reactions and from the radioactive fission products in the fireball. Like the neutrons, the gamma rays from the nuclear reactions are emitted and absorbed in a second or less. Gamma rays from the rising fireball, however, will be received for perhaps 60 seconds, or until the fireball has reached an altitude such that ground intensities are greatly reduced by distance and atmospheric absorption. With this time spread, evasive action is of some value if adequate shelter is immediately available.

Effective shields must be relatively massive because of the penetrating nature of gamma rays. About 5 inches of concrete are required to reduce the gamma ray dose by one-half. Unshielded personnel within three-quarters of a mile from a nominal bomb will probably receive a lethal dose of gamma rays.

Blast, thermal radiation, and prompt penetrating radiation constitute the triple-threat of the nuclear weapon in the immediate vicinity of the blast. The fourth and most variable threat lies in the radioactivity contained in the fireball. Fission products as formed are highly unstable nuclei and achieve stability only by emitting one or more beta particles. Penetrating gamma rays accompany many of the radioactive decays. Since the half lives range from small fractions of a second to many years, the hazards will decrease rapidly early after detonation, but will persist for very long times.

The radioactivity associated with the fission products is truly enormous. In a nominal detonation the gamma ray activities will be

1 minute	800,000	megacuries
1 hour	6,000	
1 day	133	
1 week	13	
1 month	2.3	
1 year	0.11	
10 years	8,000	curies
100 years	600	

These figures can be put in proper perspective by recalling that one curie is the activity associated with one gram of radium, and that the world supply of separated radium is probably less than 100 grams.

The radiating, cooling fireball soon loses

its luminosity but continues to rise as a white cloud of bomb debris and water vapor condensed by the low temperatures at high altitude. The top of the familiar mushroom cloud will be at 30,000 to 40,000 feet for a nominal detonation.

Initially, the cloud was in a gaseous state with all its contents existing as individual atoms and molecules. There may be some aggregation with cooling but the bulk of the particles in the cloud will be very small. According to Stokes' law a 5-micron particle will require about 70 days to fall from 40,000 feet and the times for smaller particles will be even longer. During this period radioactive decay and cloud attenuation by diffusion and wind currents will greatly reduce the amount of radioactive material falling on a given area. With the high altitude "clean" type of burst described fallout might be detectable but would probably not constitute a health hazard.

A region of negative pressure is created underneath the rising bomb cloud and air sweeps inward across the surface of the earth to restore the pressure to normal. As the inrushing air meets in the center directly under the cloud it rises after the cloud to form a column or jet. This jet carries many tons of dirt scoured from the surface of the earth and if conditions are right the jet may catch up with the rising cloud and mix with it. If this mixing is early, when temperatures are still high, many of the fission products will condense onto the dirt particles. We now have radioactive material deposited on relatively large particles, and many of these will return to earth in a few hours. In this case fallout will occur close to the point of detonation, and the levels of activity deposited may be high for there will have been little time for decay and diffusion.

In a low level or a contact burst the fireball will intersect the surface of the earth and we have an aggravation of the contaminating situation just described. Here there will be a thorough high temperature mixing of fission products and dirt particles and a substantial fraction of the active atoms will deposit onto macroscopic particles before the fireball rises.

Events subsequent to the condensation depend upon the vagaries of the weather. Fallout may be heavy, along a narrow path, and levels of activity may be high. On the other hand, a high wind shear may spread the contamination over great areas with a corresponding reduction in radiation levels.

Calculation of the hazard associated with a given set of meteorological conditions is difficult and not entirely reliable, but an idea of the hazard can be obtained by a few simplifying assumptions. If one per cent of the activity should fall out at one hour there would be a total fallout of 60 megacuries. About 25 megacuries per square mile will produce a serious radiation hazard so with uniform distribution about 2.5 square miles could be badly contaminated. The situation does not appear serious for a nominal 20 KT weapon but if one scales up the fallout areas by a factor of 100 or 1000, to take account of new, more powerful weapons, danger areas become very large. With the larger weapons fireball sizes are so large that every burst will probably be a contaminating event. With these weapons the fourth threat comes into its own to produce a total destructive potential to personnel and structures almost beyond comprehension.

Mechanical and Secondary Missile Injuries*

By

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AS YOU probably know by now, an atomic detonation causes damage by means of three principal effects. It produces ionizing radiation which is emitted in the first place at the time of detonation but also later in areas that are contaminated with bomb debris, so-called fall-out areas. It produces a tremendous amount of heat which can burn persons at distances of many miles from the point of detonation and ignite materials also at great distances. And lastly, by means of a blast wave propagated over great distances it causes mechanical injury and damage.

The first effect, ionizing radiation, is unique to a weapon, it is a completely new factor in warfare.

The second effect, thermal radiation, is new in the sense that ordinary high explosives do not produce much heat in comparison to their other effects and there are no burns produced many miles from the point of explosion.

But when we come to the third effect, that of blast, we feel that we are dealing with a well-known effect which causes the same types of injuries that have been produced by weapons since man first used sticks and stones to attack and injure his fellow man.

However, although most of the injuries produced by blast effect are the same sort of injuries that surgeons have always had to treat, namely lacerations, contusions, fractures, etc., the way in which they are produced, the tremendous numbers that occur, the distances over which injuries can occur, and whether or not direct blast effects can cause significant numbers of casualties, are matters that are of considerable interest.

In discussing blast injuries we first classify these injuries into two categories, direct blast injury and indirect blast injury. Direct blast injury as the name implies is due to the action of the shock wave on the body. Indirect blast injury is injury caused by the blast through the medium of other objects.

It may be useful to consider the units that are used to measure blast. The unit is pounds per square inch over-pressure, usually abbreviated as *psi*. About 3 psi will seriously damage an ordinary dwelling. 7.4 psi will severely crack 12 inch brick walls. About 25 psi will collapse reinforced concrete buildings. But a man requires about 100 psi to kill him by direct blast effect alone. This figure of 100 psi is not a perfectly agreed upon number. One can find figures as low as 40 or 45 psi and as high as several hundred psi. And the pound per square inch over-pressure is not the only parameter to be considered. Some of the other factors contributing to the damaging effect on the living organism are the rate of change of pressure, the duration of the pressure peak, and the number of pulses involved. At the present time one cannot say with assurance what relative weight to assign to the various factors. In a qualitative way, however, one can state the effect of some of these factors. The more rapid the increase in pressure, the lower the over-pressure needed to cause injury. The longer the duration of over-pressure, the lower the over-pressure needed to cause injury. And multipulsed blast waves are more effective in causing injury than single pulsed waves.

And now to consider something of the types of injuries to be expected, the mecha-

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nism of primary blast death, and where and to what extent primary blast may produce injury.

Of the types of injuries to be looked for one of the most obvious is rupture of the ear drum. It is interesting here to mention that of the hundreds of thousands of Japanese exposed at Hiroshima and Nagasaki there were only 17 ruptured ear drums observed at Hiroshima and 22 at Nagasaki. Presumably the reason for this small number is that these atomic detonations had a relatively slow increase of pressure as compared to the very sudden increase of pressure of high explosive. It is very difficult to decide whether there were any other examples of direct blast injury among the Japanese. Loss of consciousness, tinnitus, vertigo and headaches were symptoms reported in about 15 to 20% of the Japanese and these symptoms were in all probability direct effects of blast. We also do not know whether there were any cases at Hiroshima and Nagasaki of death from direct blast. If any such cases occurred they would have been obscured because of later burning of the bodies and because no post-mortem studies were made.

Now we should ask how does direct blast kill or injure an animal or a man. At various times in the past it has been observed that people in the vicinity of an explosion were killed without visible signs of damage. Some observers at the time of World War I when the concept of "shell shock" was predominant thought that these cases were examples of central nervous system damage. Since then considerable work has been done in elucidating this problem and at the present time it is pretty well agreed that several mechanisms play a part. The first and most important seems to be due to the fact that the chest wall is an elastic structure with good transmission characteristics for a shock wave. Second the lungs are organs which tear rather readily and contain both air and blood in close proximity. A shock wave striking the chest and tearing the lung may permit air to enter the blood stream. Air emboli resulting from this and entering the coronary arteries produce death very promptly. These emboli can also go to the brain, block small arteries there and cause various symptoms and even death depending on what part of the brain is damaged. As well as air getting into the blood stream, the contrary can happen and pulmonary bleeding can occur.

Another mechanism of direct blast injury is direct damage to the heart, "commotio cordis" caused by direct transmission of the blast wave through the chest wall. There seems to be little question that this takes place, but it is a much less frequent and important cause of direct blast death than air embolism.

What then is the importance of primary blast damage? Are we likely to get many casualties from this cause after an atomic bombing? The truthful answer must be that as far as we know at the present time and despite the considerable theoretic interest in the pathological mechanisms of this type of injury, it is not likely to be the cause of many casualties. The radii of other bomb effects extend out so much farther than the 100 psi circle that there seems rather small chance of a person surviving other bomb effects and falling victim to direct blast action.

There is one exception to this rule that should be mentioned. It is theoretically and apparently practically possible to construct a shelter that would protect against thermal and ionizing radiation and still permit a blast wave to enter. The blast wave might even be more damaging in the shelter than in free air outside due to a focussing effect and due to reflected blast waves from the walls of the shelter. There have been examples of soldiers in shelters being killed by high explosive blast who from calculations of the psi at the distance would not have died had not reflecting and focussing effects intensified the blast wave. The proper construction of shelters is still something to be worked out although certain features we know should be avoided. Insufficient baffling at the entrance is one construction feature to be avoided. Too small a shelter

is another one. The pressure in a small shelter can rise higher and much more quickly than the pressure in a larger shelter. These are, to be sure, problems for the engineer, but as in so many aspects of atomic defense, the doctor's opinion will be asked and the best solutions will come from the engineer and the doctor with proper training, working together.

A great deal has been said about direct blast effect. It is really almost too interesting for its importance. The same cannot be said of indirect blast effects. At Hiroshima and Nagasaki there were more casualties due to indirect blast effects than from any other cause.

What is indirect blast effect? A few examples are better than a definition. If a blast wave hits a building that I am in, and the building collapses and crushes me, I am a casualty due to indirect blast effect. If I am in a building and a blast wave hits a window and a piece of glass pierces my chest, I am a casualty due to indirect blast effect. Falling buildings, flying bricks cause the injuries due to indirect blast effects. General Cooney is usually given the credit for the statement that "a toilet seat flying through the air at 100 miles per hour is as dangerous as a bullet." And, of course, it is small consolation to me to consider that it takes 100 psi of direct blast to kill me if I am picked up bodily and deposited on my head a hundred feet away—another death due to indirect blast effect.

The injuries will be of every variety that mechanical causes can produce, and, of course, can be grouped generally into fractures, lacerations, and contusions. The statistics from the Hiroshima and Nagasaki bombings are interesting for one reason and this reason diminishes the value of the statistics as a basis for predicting types of casualties. The statistics show a very low percentage of fractures, so low—of the order of 5 to 6% and less—that we are reasonably certain that it did not really happen this way. The usual explanation is, and we have every reason to think the explanation is true, that those with fractured legs were unable to get out of the wreckage and move under their own power to hospitals or other medical aid; consequently these people died without getting medical attention and being entered in the statistics.

If organization for passive defense is effective and rescue teams are able to get in and evacuate casualties we will undoubtedly see a higher percentage of fractures among the casualties than occurred with the Japanese.

The various types of mechanical injuries due to indirect blast effects will not differ in any way requiring different medical handling from injuries caused by conventional weapons, but there are two features to keep in mind.

One, which is being drummed into you to the point of saturation, is that the numbers to be treated will be immense. This of course means that definitive treatment cannot be used, but assembly line methods will have to be devised.

The other is that many of these patients will have received doses of ionizing radiation and will not respond as well as they would otherwise.

Aside from these two features, nothing strange should be looked for in these various types of mechanical injury.

Summing up then we can say that blast injures in two ways, by direct blast effect and by indirect blast effect. The first will probably not be too important as a mass producer of casualties although there are possible exceptions under special conditions.

The second way, indirect blast effect will produce huge numbers of casualties but these are types with which the doctor has always been familiar.

Thermal Injuries of Nuclear Warfare*

By
HERMAN E. PEARSE, M.D.†

IT HAS been estimated that some 70,000 Japanese sustained burns at Hiroshima, of which about 40,000 were serious enough to require treatment. This is nearly 200 times the number of cases which strained the medical facilities of Boston and Hartford in their disastrous fires. Tsuzuki[1] says that 90% of those who sought aid in the first week did so because of burns. Obviously it is not realistic to consider using the methods of therapy developed in our modern hospitals for such masses of burn casualties.[2, 3] There would not be sufficient personnel or equipment.

In 1947, after making a survey of the atomic bomb casualties in Japan for the National Research Council, I was greatly impressed with the magnitude of the problem of management of these flash burns. The only source of factual information was from analysis of the casualties at Nagasaki and Hiroshima, but the Japanese studies were incomplete while ours were delayed. There were gaps in our knowledge which could only be filled by additional observations in the experimental laboratory or in field tests.

The first requisite of rational therapy is to understand the lesion to be treated. Hence the first step toward solution of the problem of the mass management of flash burns was an increased knowledge of the characteristics of the lesion. This could only be gained by research. Support for this was obtained from the Atomic Energy Commission who have continued financial aid and in addition have given intelligent, sympathetic understanding of the problems involved. Much has been learned, yet many questions remain unanswered. The following is a summary of some of the results obtained to date by our laboratory.

Laboratory Sources. In order to simulate the thermal energy released by the atomic bomb, laboratory sources must be created which have a suitable level of radiant thermal flux, a comparable spectrum and a controllable time of exposure. Of all the methods tested the carbon arc[4] has been the best for small area studies, and burning magnesium[5] the best for large area burns.

Experimental Animals. Moritz et al.[6] first showed that the skin of white pigs closely resembled that of humans. For this reason we have usually used Chester White pigs of 10 to 15 Kg. weight. A few experiments have been done on dogs and rats to evaluate species differences. Enough human burns have been studied[7] to compare, on a statistical basis, the energy required to give equivalent lesions. It was found that in a human with slight pigmentation 1.2 cal/cm^2 was required to cause a first degree burn in 0.3 sec., while 1.3 cal/cm^2 was needed for a white pig. A second degree burn in the human required 2.3 cal/cm^2, while in the pig 2.1 cal/cm^2 was needed. Thus dose-response studies in the pig are valid for prediction of results in humans up to the level of severity studied. Pig skin has deeper hair follicles than human skin so that observations on healing in "full thickness" burns may not be comparable.

Calorimetry. A fraction of a gram calorie may alter the severity of the burn. Methods of measurement have been devised for accurate evaluation of the thermal energy applied by laboratory sources. In field tests equipment was used to measure the energy incident on the skin at different distances from the bomb.

Spectroscopy. The thermal energy released by a bomb explosion may be modified by nitrogen dioxide, ozone, atmospheric

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opacity to short waves, absorption by water or other factors. Different surfaces exposed to this thermal energy may have widely divergent absorption of the same wavelengths. Thus a knowledge of the spectral characteristics of the radiation and the test object must be known. Methods for measuring these have been developed and are constantly being improved. By filtering out portions of the spectrum the dose of any band required to give equivalent severity may be compared with other wavelengths. In general, it has been found that the shorter the wavelength, the less the energy required to create the same severity of damage.[8] In field tests[9] no burns were observed through filters which admitted only ultraviolet light. Burns behind filters that admitted visible or infrared radiation were about equal in severity.

Pathology. Flash burns result from a brief exposure to very high intensity thermal radiation. The heat is so intense that severe surface damage results, but its application is so short that a steady state of heat flow does not occur. This results in an all or none phenomena with a sharp demarcation[10] both laterally and in depth, between burned and uninjured tissue. The microscopic picture is quite unlike that described[11] for burns from longer exposure to lower temperatures. This phenomena is time dependent and is less apparent in burns from exposure of more than one second. It is not seen in those from long exposures or in those sustained behind fabrics. It causes severe surface effects without the penetration in depth that the clinician associates with such surface appearance. The relation of surface injury to depth of damage has been evaluated.[12, 7]

Mortality from a burn is influenced by the age of the subject, the percent of skin surface involved, and the depth of the injury. We have advanced the concept[13] that the percentage mass of skin burned in relation to the mass of the body is the critical factor. In pigs this may be arrived at by measuring the hemoglobin content of the plasma.

In spite of the thousands of flash burns at Hiroshima and Nagasaki, there was not a single immediate biopsy available to illustrate the histological changes produced in the skin. Many sections taken from Japanese casualties were reviewed, but all were obtained late after infection or repair had set in. Likewise at the Bikini tests, where emphasis was focused on the effect of ionizing irradiation, no immedate skin biopsies of thermal burns were to be found. Thus, to validate our observations from laboratory sources, animals had to be exposed to the thermal radiation from atomic bombs and the gross appearance, microscopic changes and healing compared. In every case they were found to be identical.

The severe surface injury and sharp demarcation seen in flash burns has a profound influence on the mode of their healing. We recognize five levels of surface injury, namely, erythema, patchy white burn, uniformly white burn, steam blebbed burn and carbonized burn. When there is sufficient damage to cause coagulation or carbonization an impervious eschar is formed on the surface. If this is not broken or removed it forms an ideal covering for the lesion. There is little or no zone of partial damage so that healing proceeds beneath the coagulated eschar which acts as a bridge for the propagation of new epithelium orginating from the hair follicles. When epithelialization is complete the eschar is sequestrated. It is an ideal setup for non-interference by the surgeon. We have had only one chance to follow this course in a severe flash burn from accidental explosion of magnesium, causing second degree burns of the face, and third degree burns with carbonization, of the hand. The face was treated by exposure to the air and the hand was covered with a dry sterile dressing to avoid added trauma. Prompt and complete recovery followed without residual disability. Thus, knowledge of the characteristic pathology of experimental flash burns gave a clue to their clinical therapy.

Time of Burning. The manual on "The Effects of Atomic Weapons"[14] (Fig. 6.6)

shows an initial flash of very high intensity which drops to a minimum of about 2000° K in .015 seconds. A short null is followed by a second maximum from the fire ball to about 7000° K in 0.3 seconds after which the temperature falls. Nearly all of the thermal radiation is emitted in three seconds. Thus the burn from an atomic bomb might occur anywhere in the range from .015 to 3.0 seconds. Laboratory studies and military predictions required a precise knowledge of the time of burning. By means of "flip" shutters[9] which closed one port while opening another at various times after bomb zero, it was found that: a) no burn occurred in any animal at any station from the initial flash; b) the burn from the fire ball was equal in severity to the burn from exposure to the total pulse; c) the burns produced in the period between 0.1 and 0.2 seconds were the most severe of any 0.1 second fraction of the thermal pulse; d) the major burn severity was sustained within the first 0.3 seconds; e) no burn was produced after 0.6 second. Thus evasive action is not effectual.

In laboratory work the time of exposure must be accurately controlled. Electronically operated shutters have been developed which do this precisely within .01 second. Knowing the exact exposure in terms of time and thermal energy one is then in a position to learn the exact dose-response of skin to thermal injury. This is not only of basic importance to burn research, but also is of practical value in civil and military predictions of casualty production. Such dose-response studies[7, 15] have been made in 2500 burns, over a wide range of applied thermal energy and exposure times. These not only established a precise dose-response pattern but also showed that: a) prolonging the exposure time did not effect the depth of damage in 1+ and 2+ burns; b) that the 2+ burn causes dermal-epidermal separation so is comparable to the second degree burn of humans; c) prolonging the exposure time beyond 1 second causes a marked increase in the depth of dermal damage of the severe burns. For example, in the white burn (3+) the depth of dermal damage increases from 100 μ with 1 second to 1000 μ with 10 seconds exposure; d) at long exposure times less energy is required to cause deep dermal damage than to cause severe surface injury.

Effect of Ambient Temperature. The Japanese bombing was done in August when the weather was hot. This probably increased the number and severity of the casualties. To control laboratory studies and to gain a clue to the influence of environmental temperature on casualty production studies were made on the effect of the ambient temperature.[16] It was found that by lowering the room temperature the skin temperature could be made to fall within limits. This could be accentuated by giving CHLORPROMAZINE. For each degree centigrade fall in skin temperature there is a 3 to 4% increase in the thermal energy required to cause a 2+ burn.

Protection against Flash Burns. Knowledge of how to avoid flash burns from an atomic bomb may be more profitable than their cure. The greatest protection is afforded by adequate distance from the bomb burst since this lowers the level of applied thermal energy. Lacking this the next most effective method is screening behind earth, buildings or other obstructions for the thermal radiation travels in a straight line. Three other protective methods have been studied for those who are exposed.

Protective Skin Creams. A study of substances that increase the reflectance of the skin and so reduce the energy absorbed have not, as yet, proved profitable. This is largely due to the reluctance of troops to use such creams and to the danger from the vehicle which suspends the reflective substance: For example, if a grease is used it may ignite and accentuate the burn. At present this subject is being restudied in our laboratory.

Protective Clothing. It was evident that the color, weight and composition of clothing worn by some of the Japanese modified the severity of their burns. This led to a study, by some government agencies, of the effect of high intensity, radiant thermal energy on fabrics. In 1950 we, in conjunction with

representatives of the Surgeon General of the Army, advanced the thought that it was less important to know what happened to the fabric than to the man beneath it. The following year laboratory[17] and field[9] studies were made which showed that skin burns occurred beneath cloth that wasn't even scorched and conversely no burns occurred with other fabrics that were themselves damaged. This led to a project supported by the Quartermaster of the Army to study the fundamental factors involved in the protection from clothing. Much detailed information was obtained[18, 19, 20] which cannot be recorded here for want of space. The major practical observations may be summarized as follows: a) the greater the optical reflectance of a fabric, the greater its protective value. In general black absorbs and white reflects the thermal energy; b) the greater the weight, the more the protection; c) multiple layers give more protection than single fabrics. This may be increased to the point where six layers will protect against over 108 cal/cm^2, a range that is well within the zone of other lethal effects; d) flame proofing is of little value if the fabric is in contact with the skin; e) an air space of even 1/2 cm increases the protection 5-fold, provided the fabric does not ignite. Flame proofing is of value here; f) the composition of the fabric may have influence, for example, woolen cloth gives more protection than cotton; g) substances distilled from the cloth may be deposited on the skin and appear to cause damage in some cases; h) the burn beneath a fabric resembles more that from prolonged contact with lower temperatures rather than a true flash burn.

Protective Shielding. If a fabric or other shield is interposed between the animal and the source of thermal radiation a set of circumstances different from that of clothing is obtained: experiments have been conducted in which large areas of cloth have separated a pig from burning magnesium. This would simulate being under a tent or behind a screen of fabric. Unshielded animals received an exposure to bare skin which caused 3+ burns on 93% of their skin surface. This would be lethal. Shielding by some fabrics reduced this to 33% of 1+ burns which is not a serious lesion. Valuable protection would be afforded by this means for military or civilian personnel.

Conclusion

An attempt has been made to summarize the findings from our laboratory without giving an exhaustive review of the subject. It has been emphasized that flash burns, because of the unique physical factors that produce them, deserve study. It is hoped that through painstaking analysis of the characteristics of this burn will come a rational clinical management.

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Radiation Injuries Resulting from Nuclear Explosion and Fallout*

By
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INTRODUCTION

RELIABLE information has been reported concerning the effects of nuclear radiation in human beings as a result of their exposure to: (a) immediate nuclear radiation,[1a, b, c, d, 2, 3, 4‡] (b) residual radioactivity,[5, b] and (c) radioactive fallout of moderately severe intensity.[6, 7]

No human beings have been exposed to *residual radiation or to radioactive fallout for a prolonged period of time.* The effects of such exposures have not been observed in man.

No instances of *radioactive poisoning* or of *significant internal radiation* have occurred as a result of the detonation of an atomic bomb or a high-yield nuclear weapon.

RELATION OF RADIATION HAZARDS TO RADIATION EFFECTS IN HUMAN BEINGS

Although residual radioactivity and radioactive fallout have received much attention of late, it should be recognized that these phenomena were observed following the first atomic bomb test in New Mexico in 1945. Residual radioactivity at the bombsite proper has been studied by survey parties under contract to the Atomic Energy Commission.[8] Cattle not far from the test site suffered skin burns and subsequent graying of the hair on their backs as a result of radioactive fallout.[9] Water a great distance from the test site was contaminated by fallout.[9]

In event of enemy attack with high-yield nuclear weapons, radioactive fallout may be of major concern.[10]

It is not possible to predict the size and kind of bomb an enemy might use against us in event of war, the exact means of delivery, the height at which it would be exploded, or the number of bombs which might reach a given target.[11]

The question of the area of contamination to be expected from the detonation of nuclear weapons cannot be answered categorically without specifying (a) the degree of contact the fireball has with the surface of the earth and (b) the characteristics of the surface over which the bomb is detonated. The characteristics of the radioactive fallout and of the residual radioactivity will differ somewhat, perhaps significantly, whether the bomb is fired over water, a sandy desert, or a coral reef.[12] Conceivably, these differences could have an important bearing on what might be anticipated from the medical standpoint, particularly in connection with the internal radiation hazard.

"The phenomena of blast, heat, and nuclear radiation from the detonation of a thermonuclear bomb are of the same nature as those of the earlier and smaller atomic

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‡ In 1946, at the Los Alamos Scientific Laboratory two accidental nuclear reactions occurred which injured 10 persons. These were temporarily uncontrolled nuclear fission reactions. As a consequence, the entire bodies of the affected individuals were exposed to penetrating ionizing radiation. The effects observed were due chiefly to moderately fast neutrons and hard gamma rays. There were two deaths. While these injuries did not occur as a result of the detonation of a nuclear weapon, they are of specific interest because (a) they did occur in a weapons development program and (b) they may have an important relation to the effects observed as a result of exposure to the immediate radiation of a nuclear weapon. The observations on these cases were reported in the Annals of Internal Medicine, 36:2, part 1, (February) 1952.

bombs. The nature of the phenomena is, in general terms, standardized whether the bomb be a 20,000-ton (TNT equivalent) atomic weapon or a thermonuclear one of many times that power."[13]

This fact is of great importance because it means that the information gained from the atomic bomb tests at Alamogordo (1945), Bikini (1946), and Eniwetok (1948) can be utilized in meeting the problems of residual radioactivity and of radioactive fallout caused by the detonation of a high-yield nuclear weapon.

The same is true with respect to radiological safety measures.

Our schemes for Radiological Defense, as initially devised, were intended to meet the problems which it was recognized at that time could be created by the persistence of residual radioactivity and of fallout after the detonation of an atomic bomb. The underwater test at Bikini had already given rich opportunity for studying the practical problems of radiological safety and this under conditions of unusual severity and complexity.

The principles and the techniques of radiological safety are just as applicable in meeting the problems created by the residual radioactivity and the radioactive fallout from the detonation of a high-yield nuclear weapon as those produced by an atomic bomb. The importance of instrumentation in the detection and measurement of radiation hazards arising from fallout has recently been stressed by Commissioner W. F. Libby.[14]

The primary purpose of all radiological defense monitoring schemes is to prevent injurious radiation effects due to excessive and avoidable exposure of personnel to residual radioactivity and to radioactive fallout.

Effects of Immediate Nuclear Radiation

A. *Radiation Sickness (Acute Radiation Syndrome).* As observed in Japan, the patients suffering from radiation sickness could be placed in three groups, depending on the characteristics of the clinical findings and the severity and course of the illness. There was a close relationship between the severity of the exposure and the gravity of the illness.

In the *extremely severe cases,* prostration, malaise, nausea, and vomiting began one or two hours after exposure and continued for several days. Leukopenia and particularly a lymphopenia were observed early, and both tended to be persistent and severe. Within a few days, there was diarrhea, and it also tended to persist. Fever was present within a few days. Generally, the earlier its appearance the more grave the illness. The usual outcome was death some time before the end of the second week, at times just a few hours after exposure. If death did not take place until late in the second week, epilation and purpura were sometimes observed. The hemorrhagic manifestations were probably not responsible for death in these very severe, rapidly fatal cases.

In the *severe cases,* nausea and vomiting occurred on the first day but usually did not persist for more than 24 hours. Prostration was not a prominent early symptom. There was a lymphopenia after the first day. After these early symptoms, a latent period (4 to 20 days) was common, during which there was steadily increasing malaise, the patient tired easily, and the lymphocyte count was depressed. Once the latent period was over, an acute exacerbation of symptoms occurred, and the patient became seriously ill. Symptoms then commonly encountered in varying combinations were: (a) epilation, particularly of the scalp; (b) purpura and other hemorrhagic manifestations, such as, melena and bleeding from the nose and uterus; (c) edema, infection and ulceration of the oropharynx; (d) fever; (e) diarrhea; (f) severe leukopenia; (g) secondary infections; (h) breaking down of healing wounds or delayed healing; and (i) general sepsis. The severe hemorrhagic tendency was characteristic. When death occurred, it was usually

due to loss of blood, to general sepsis, or to hemorrhages into vital structures. Hemorrhages were, at one time or another, observed in all of the various tissues of the body, including the brain and heart muscle. In those cases terminating fatally, death usually occurred before the sixth week. The blood changes were most marked during the third to fifth weeks. These included severe leukopenia, severe anemia, thrombocytopenia, and prolonged bleeding and clotting time. Increased permeability of the capillaries was frequently noted. In those cases where recovery took place, the return to normal was slow, with the anemia and general weakness often continuing for some time. It has been estimated that the mortality rate in this group was between 25 and 50 per cent.

In the *mild to moderately severe cases,* vomiting may have occurred some time the first day. During the ensuing two weeks, there were usually no symptoms, although, if a blood count had been taken, a moderate lymphopenia would have been observed. After the second week, one or several, rarely all, of the following symptoms were observed: (a) epilation of the scalp; (b) malaise in varying degrees and usually persistent; (c) sore throat; (d) petechiae of skin and mucous membranes; (e) diarrhea, perhaps bloody; (f) loss of appetite; and (g) loss of weight. The "latent period" was longer than in the more severe form. The blood changes were less marked and their appearance occurred somewhat later in the course of the disease. Deaths occurred mainly after the sixth week. They were usually due to some complication, such as, tuberculosis, bronchiectasis, chronic abscesses, septicemia, anemia, or malnutrition. Less than 10 per cent of the patients in this group died.

The diagnosis of radiation sickness and the evaluation of its severity are primarily clinical problems. In most instances, they can be satisfactorily made solely on the basis of the history and the physical examination. Laboratory studies, when they can be made, may provide additional assistance of particular value in estimating the severity of the illness.

B. *Delayed Radiation Effects.* The Atomic Bomb Casualty Commission, which is administered through the National Academy of Sciences, was established to continue the long-range study of the delayed radiation effects among the survivors at Hiroshima and Nagaski.[15a]

By early 1950, 45 cases of opacity of the lens believed to be due to radiation had been identified among the survivors who were within 1,000 meters from ground zero at the time of the explosion of the bomb.[15b] Since then, approximately 55 additional cases have been observed.[15c] Only a few opacities produced a significant visual defect or required an operation. Some have regressed. Many have changed little since first observed. The opacities are similar to those which have at times been observed following exposure of the eyes to X-rays. There was considerable belief that the opacities were due to neutrons emitted during the initial radiation.

Up to January 1, 1954, representatives of the Atomic Bomb Casualty Commission had identified 92 cases of leukemia among the survivors of the atomic bombings at Hiroshima and Nagasaki.[15d] Fourteen of these were in individuals who were more than 2,500 meters from the "hypocenter" at the time of the explosion. The relation between the severity of the radiation exposure and the occurrence of leukemia was striking. The peak of incidence occurred in 1951. There was a marked decline in 1953, and it is believed that this trend will continue.

Effects observed in the survivors suggest that neutrons as well as gamma radiation played an important role in producing the leukemia. The same biologic evidences indicate a more intense and extensive neutron flux than had been estimated by the physical scientists.*

* Moloney[15d] makes an interesting observation which, because of its important implications, is quoted: "Since the inception of the program of

There appeared to be a "latent period" of several years between the exposure and the appearance of the leukemia.

Fifty-two cases were of the acute or subacute form. Of these, 25 were acute myelogenous.

Forty cases were of the chronic form. Of these, 39 were chronic myelogenous.

The leukemia observed among the irradiated survivors was similar clinically and pathologically to that in the nonirradiated Japanese.

Except for the lens opacities and the increased incidence of leukemia, other observations have been suggestive only and do not merit discussion at this time.

Beta Radiation Burns Resulting From Accidental Exposure to Residual Radiation

Four scientists exposed their hands to fairly large doses of beta radiation during the atomic weapons test at Eniwetok, May 1948.[5a]

Knowlton and associates[5b] have described in masterful fashion the clinical findings in these individuals. Their report is of historical significance because this was the first time human beings had been injured by exposure to residual radioactivity resulting from the detonation of an atomic bomb. It was estimated that none of the scientists received more than 15 r of whole-body gamma radiation, and that their beta ray exposures varied from 3,000 to 16,000 rep (roentgen equivalent physical) to the outer surface of the skin. The beta rays were of 1 Mev. maximum energy. Three of the exposures were of sixty minutes duration and one of forty minutes. All were direct bodily contact with the radioactive contamination. The authors state that at no time was there any significant evidence of other than local damage.

Two of the three most severely injured scientists felt a tingling sensation in their hands during exposure. All three had stiffness of the fingers and their hands became swollen within a few hours. The skin did not redden until the second day. The amount of swelling and redness was proportional to the severity of the injury. During the third day, the erythema and swelling decreased. Following or accompanying the appearance of a secondary erythema (3-14 days), blisters began to develop. By the fourth week, they involved the entire palms and fingers of the more severely injured individuals.

The reaction reached its maximum between the twenty-fifth to thirtieth day after exposure. This was followed by the loss of dead skin and a gradual healing of the wounds. In the severe cases, ulcers that were slow to heal developed in the injured areas.

The outer fifth inch of the skin absorbed most of the radiation. The underlying tissue suffered slight, if any, damage. In this respect, the changes observed resembled those of thermal injuries more than those caused by X-rays which damage the underlying tissues. The cells died gradually over a period of weeks rather than at once as they do in thermal injuries.

The leukocyte and neutrophil counts as well as the sedimentation rates were increased. These responses accompanied the development of the vesicles and the febrile reaction which took place during this time. The localized tissue damage was probably the cause of these hematological changes.

There were no significant changes in the lymphocyte, erythrocyte, or platelet counts, nor in the hemoglobin values.

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the Atomic Bomb Casualty Commission analysis of data has repeatedly shown a discrepancy between the biologic effects and dose of irradiation as officially estimated by the physicists. It has been stated that the dose of gamma irradiation was 25 r at 2,000 meters from the hypocenter and that the neutron flux only extended to 800 meters. However, biologic effects, as evidenced by carefully obtained histories, indicate that symptoms and signs of severe irradiation sickness were present in survivors out of 2,500 meters. It has also been shown that lens opacities caused by irradiation have been noted at 1,700 meters. Since irradiation cataracts were undoubtedly caused by neutrons the neutron flux probably extended much farther and was more intense than had previously been estimated. The implications are that neutron activity may well have been involved in leukemogenesis among survivors of atomic bombing."

In the three severely injured scientists, it was necessary to perform surgical debridement and to resort to plastic surgery to take care of the superficial ulcerations which continued to be bothersome seven months after exposure. The recovery of the use of the fingers has been surprisingly good.

The scientist with the mildest injury had completely recovered by the fiftieth day after exposure. The skin of the injured hand was normal in appearance.

All of the scientists received careful medical attention. Three were hospitalized. All have had good recoveries and have returned to work. Their injuries will not require them to change their type of work.

Knowlton and associates[5b] have described the clinical response to the skin irradiation as divided into four phases:

"1. A sensation of tingling and itching at the time of exposure followed within a matter of hours by a slight erythema and edema (sometimes associated with blanching of the skin), which lasts for two to three days.

"2. A latent, asymptomatic period of three to five days.

"3. A secondary erythema, which is soon followed by vesicle and bulla formation. These vesicles dry and desquamate after about three weeks, leaving a new layer of thin epithelium.

"4. A chronic phase characterized by atrophic epithelium and loss of secondary epidermal structure. Telangiectases, hyperkeratoses and malignant degenerations are potential complications which may develop over a period of time."

The same authors point out that, in persons receiving a lesser exposure, phases 1 and 2 may pass unnoticed or may be absent altogether. Also that, because of the time lapse between exposure and phase 3, any exposure to beta radiation should be taken seriously.

Effects of Exposure to Radioactive Fallout

Following the detonation of a high-yield nuclear device at Bikini Atoll on March 1, 1954, 28 American test personnel, 239 natives living in the Marshall Islands, and several Japanese fishermen aboard a fishing trawler were exposed to radioactive fallout.[6] Those with the heaviest exposures received whole-body gamma radiation, beta radiation injury to the skin, and minimal internal contamination.

A team composed mainly of personnel from the technical staffs of the Naval Radiological Defense Laboratory and the Naval Medical Research Institute initiated a study of the medical effects within ten days of the detonation.[16] A portion of this study was reported before the American Medical Association in June 1955.[7] This report has considerable historic, as well as professional, interest because it presents, for the first time, observations made on the effects of radioactive fallout on human beings.

The 64 Marshallese living on the Rongelap Island group received the heaviest exposure. This was calculated to be a whole-body dose of 175 r of penetrating gamma radiation.

The natives in the other island groups and the Americans received considerably less exposure.

The authors devote most of their presentation to findings observed in the group receiving the heaviest exposure.

During the first 48 hours, two-thirds of those in the Rongelap group suffered from nausea and one-tenth vomited and had diarrhea. In addition to their general systemic reaction, a considerable number experienced itching of the skin, and a few reported burning of the eyes during this period.

Supervised decontamination and medical care could not be provided until they were evacuated to Kwajalein Island two days after exposure. By this time, the initial symptoms had subsided.

Hematological changes were impressive. Lymphopenia appeared promptly and persisted to some degree for a prolonged period of time. Neutropenia and thrombocytopenia occurred in all of the individuals of the group most heavily exposed. The lympho-

cyte, neutrophil, and platelet counts showed two peaks of maximum depression, with a clear-cut interval of time intervening. Hematocrit determinations were not remarkable.

The neutrophil counts fell to 70 to 80 per cent of the control groups during the second week, then fluctuated until the fifth week. At this time, a second depression began which reached a low of approximately 50 per cent of that of the controls. The counts remained about 75 per cent of the control values during the ten weeks of closest observation.

The lymphocyte counts of the adults by the third day were 55 per cent of the control values, and they remained at approximately this level throughout the study. The lymphocyte counts of the younger group (0-15 years) fell to 25 per cent of the control values before the third day. Shortly after this time, their counts began to rise, and recovery in this group was more rapid than in the adult group.

The fluctuation in the leukocyte counts was a reflection of the changes in the neutrophil counts.

Platelets were not counted until the tenth day, at which time, in the female group, they were approximately 60 per cent of the female control group. They fell to 30 per cent of the control values during the fourth week. At this time, 20 per cent of the Rongelap group had platelet counts of less than 90,000 per cubic millimeter. There was a slight rise in the counts during the fourth and fifth weeks. During the seventh and eighth weeks, a second decrease took place, and the counts remained thereafter at about 70 per cent of the control value. The pattern of the platelet counts in the males was similar to that in the females.

The less heavily exposed groups showed similar but less pronounced hematological changes. This was consistent with the lower doses of exposure calculated for these groups.

The time and course of the hematological changes corresponded most closely with those of the "low dose" group of Japanese victims of the Hiroshima and Nagasaki bombs. In these individuals, although definite signs of severe radiation exposure were present in some, yet none of them died as a result of radiation effects.

"Comparison with hematological data in Japanese groups in which fatalities occurred make it probable that exposure in the highest exposure group of Marshallese was moderately severe, probably within 50 to 100 r of the level where some fatalities would have resulted."[7]

Contamination of the skin and internal contamination probably did not contribute significantly to the depression of the hematological elements.

The blood changes were not accompanied by a diminished resistance to the minor infections observed in both the exposed groups and control groups.

There were no evidences of hemorrhage into tissue, although 11 individuals had platelet counts of 35,000 to 60,000 at one time or another.

Surface contamination of the body resulted in beta radiation injuries to the skin. Chief among these were (a) spotty epilation and (b) hyperpigmented skin lesions which desquamated from the center outward. Epilation was usually preceded or accompanied by a lesion of the scalp and appeared about the twelfth to fourteenth day (in the less severely exposed group about the twentieth day). Epilation occurred about three times as frequently in the children (0-15 years). It was also more extensive and severe in this age group. Regrowth of hair began at approximately nine weeks and was usually complete at six months after the incident.

Some of the skin lesions were sore and weeping. All lesions, however, healed rapidly with no further breakdown of tissues. One lesion on an ear did not heal for four months. The changes did not conform in all respects to beta skin lesions described in the literature.[5b] No primary or secondary erythema was observed. The lesions appeared on certain parts more quickly than on other parts. Biopsies of the skin lesions

taken during the third or fourth week after exposure revealed histopathological changes characteristic of radiation injury.

The degree of internal contamination was studied by means of radiochemical analyses of urine. It was believed *not* to have contributed to the acute radiation syndrome and *not* to be sufficient to produce long-term hazard.

Examination one year after exposure revealed all to be in good health. A slight depression in the lymphocytes and platelets still persisted.

Conclusion

Human beings have been exposed to most of the different kinds of radiation hazard which may be produced by the detonation of an atomic or a high-yield nuclear weapon. High lights of the effects observed have been described.

References are presented which relate the observations described to official documents of an authentic yet unclassified nature.

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Eye Injuries in Nuclear Warfare*

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THE care of eye injuries in the event of any type of disaster is a difficult problem. This is true for the following reasons:

(1) If sight is to be retained in most severely injured eyes, they must receive definitive care early. An injury which would give complete restoration of sight when treated early may result in loss of an eyeball if treated late.

(2) Improper early care by well-meaning but misinformed individuals may cause loss of an eye in spite of the best efforts of a skilled ophthalmologist later.

(3) While the eye makes up only a small portion of the total body area, its relative injury rate will be out of proportion to its size. This is true, of course, because what might be an insignificant injury elsewhere may very well be a major injury to the eye.

For these reasons, any plan for the care of injuries in nuclear warfare should include a specific plan for the care of eye injuries. This plan must be based on the following factors:

(1) The kind of eye injuries that will be produced.

(2) The number that will occur.

(3) The personnel that will be available to treat them.

(4) The facilities and supplies that will be available.

TYPES OF INJURIES

Injuries which occur will be caused by either blast, long-wave radiation, short-wave radiation or a combination of these factors.

Injuries Due to Short-Wave Radiation. Injuries due to short-wave radiation are not an immediate care problem. Cogan, Martin and Kimura stated that at Nagasaki and Hiroshima it produced the following effects in the eyes of some of the population:

(1) Keratoconjunctivitis with mucopurulent discharge one to three days after exposure (possibly due to ultraviolet radiation).

(2) Keratitis coming on three to four weeks after exposure.

(3) Retinal complications of radiation sickness occurring 10-14 days after exposure.

(4) Radiation cataracts developing in a matter of years after exposure.

Clearly, none of those short-wave radiation lesions requires any emergency care at the time of disaster. The keratoconjunctivitis cases may be acutely uncomfortable for a while but will usually suffer no serious permanent effects if not treated.

Injuries Due to Long-Wave Radiation. (Essentially visible light and infrared.) These are the burn injuries. They can be divided into the intra-ocular and extra-ocular types.

The intra-ocular burns, the chorioretinal burns produced by atomic flash, are produced by the absorption of visible and infrared light in the retinal and choroidal pigment layers. This energy absorption produces coagulation of the tissues and mechanical destruction of the choroid and retina by converting the tissue fluids to steam and thereby exploding the retina. These can be very severe lesions at near distances, especially if they occur in the macular area. Their severity depends on the clarity of the atmosphere and the pupillary diameter; hence, they will be much more severe at night. Pupillary and blink reflexes are too slow to prevent the injuries. The distances

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at which these burns may occur are much greater than those at which any other harmful direct effect of nuclear weapons may occur. In clear air, at night, such burns may be produced in humans by a 20 KT bomb to a distance of 40 miles. This is true because the optical system of the eye negates the inverse square law concerning intensities of light energy with distance. These burns are not theoretical; they have been produced in rabbits and in humans by actual atomic bomb detonations. One case of bilateral central scotomata was reported in the Hiroshima survivors. There are several reasons why more were not found; the bomb was by modern standards small; it was detonated in bright daylight so that observers had small pupils, thus severely limiting the energy entering the eye, and, so far as is known, no careful search has ever been made to find these cases.

Fortunately, these lesions require no immediate therapy. It is probable that the use of ACTH or cortisone to reduce the inflammatory reaction and cicatrization may be valuable in severe burns of this type, but immediate treatment under disaster conditions would not be imperative.

The external eye burns produced are, however, a different problem. The individual case is a type of injury with which we are familiar. This is true with both flash burns of the eyelid and eyeball and those secondary burns produced by fires started by the explosion. There is, however, this difference: In the flash burns a very high percentage of the energy is delivered in such a small fraction of a second that the eyeball may be burned before the blink reflex can close the lids (in roughly 0.1 seconds). The eyeball is much less likely to be involved in burns due to heat from flames since this is usually delivered slower and over a longer period of time and the blink reflex is ordinarily quite effective in preventing these injuries.

The therapy of individual burns of either type is well known. It is the therapy of the probable large numbers of them that presents the problem. Exact numbers of cases are difficult to determine because previously used high explosive bombs have a relatively low output of radiant energy in comparison to atomic bombs. Thus past military experience is of no assistance. In the Nagasaki and Hiroshima bombings, there was so much chaos that accurate figures are not available. Then, too, early studies had as their primary interest the effects of short-wave radiation on the eyes. They were not designed to study thermal or traumatic effects. The ophthalmologic survey of atomic bomb survivors in Japan conducted by Cogan, Martin and Kimura assumed their task was ". . . to determine . . . whether or not ocular lesions other than traumatic resulted from the atomic bombing. . . ." Flick was probably the first American to study the traumatic effects, and he states: "There were large numbers of patients exhibiting facial burns of the ordinary type with dense cicatrix. These burns in some instances involved the conjunctiva and cornea to such an extent that the red, inflamed, lacrimating eyeball had only slight movement and seemed set in a dense mass of contracting scar."

Tamura et al., reported thermal burns of the eyelids but mentioned minimal scarring. Oyama and Sasaki and Ikui mention ectropion of the lids produced by burns. Warren states that there were relatively few corneal or conjunctival burns at Hiroshima and Nagasaki and that burns of the eyelids were rarely seen. He felt that the moisture of the eyeball may have been important in preventing burns of the eyeball. It is probable that the height of the burst and the protection afforded by headgear and the overhang of eyebrows had a significant effect in the prevention of these burns. Their incidence in the future will depend upon the physical factors involved including the height of the burst, clarity of air, headgear worn, amount of eyebrow overhang, distance from burst, etc.

Because of the extremely high radiant energy output in the period prior to the blink reflex (average 0.1 second) it is probable that a considerable number of partially protected individuals may receive conjunctival and corneal burns in addition to the number who will sustain burns of the eyelids. There

are no known experimental or experience data which will permit an estimate of percentage or total numbers of such casualties.

Mechanical Injuries. Mechanical injuries are produced either primarily or secondarily as a result of blast. This mechanical effect has been the chief component of the destructive force in previously used high-explosive bombs. These mechanical injuries were studied by Hirose and by Tamura, Ikui, Nakano, Hiwatashi, and Oshio following the Nagasaki and Hiroshima bombings but they made no attempt to estimate the numbers of eye casualties nor the percentage of serious lesions in relationship to mild ones. They, too, were mostly interested in the short-wave radiation effects on the eye. However, Tamura, et al., did note that the blast effects on the eye were essentially the same as other bombardment injuries. They also noted that, of the intra-ocular foreign bodies, the most frequent one was window glass. This is significant when the relatively larger glass content of American cities is considered.

In an effort to determine the incidence of eye injuries, several reasonably well documented disasters were studied. These were the Texas City disaster of April, 1947, and the more extensive experience of the British in air raids during World War II.

In the Texas City disaster, the following pertinent points were noted:

Killed	560
Hospitalized	800
Slightly injured	3500
Major lacerations	332
Fractures	331
Head injuries	217
Eye injuries	123
Mild eye injuries	85
Severe eye injuries	38

Thus, it is noted that 30.9 per cent of the eye lesions were severe. Thirty-eight severe eye lesions represent 4.75 per cent of the total number of individuals hospitalized. It should be noted that eye lesions ranked fourth in the number of severe lesions requiring hospitalization; 2.8 per cent of all individuals injured had eye injuries and 0.87 per cent of all individuals injured had severe eye injuries.

The British experience during air raids showed that 7 per cent of the serious nonfatal casualties had severe eye injuries. Nearly one-third of these had other serious injuries. Eye injuries were the fourth most common cause of serious injury. They found that 2.7 per cent of all air raid casualties had eye injuries. These injuries were distributed as follows:

Foreign bodies	31%
Lacerations of cornea, sclera and iris	17
Gross damage	14
Abrasions of cornea	12
Subconjunctival hemorrhages	12
Conjunctivitis	6
Hemorrhage in vitreous	5
Blast effects, not serious	3

Of these injuries, 75 per cent were due to flying debris, 20 per cent to blast and displacement of the individual and 5 per cent to bomb fragments.

In the later bomb experience with more powerful bombs, the incidence of eye injuries rose to 11.7 per cent of hospital casualties. They used as a planning figure ten per cent of hospital beds for eye casualties. This same trend toward higher incidence of eye casualties with more powerful bombs could be expected to continue with nuclear weapons.

From the above figures, then, we can form a reasonably accurate estimate of traumatic eye injuries (other than burns):

(1) Of all the injured, about 2.8% will have an eye injury due to blast.
(2) About ⅓ of these will be serious injuries.
(3) About 10% of all hospitalized cases will be traumatic eye cases.
(4) These will be in addition to the burn cases which cannot at this time be accurately estimated.

Treatment of Casualties

The problem of the treatment of eye casualties resolves itself into four phases:

(1) Initial care. Either "self-help," treat-

ment by a member of the family or a roving first-aid team.

(2) Initial professional care. This will probably occur at a collecting and triage point and will probably be given by a physician other than an ophthalmologist.

(3) Initial care by an ophthalmologist. This will occur when patients are being examined to determine the definitive treatment required in each instance. For the less severe eye injuries, this may be the final treatment they receive.

(4) Definitive ophthalmological care. This will ordinarily be administered in a hospital.

Principles in Treatment. There are several basic principles that should be followed in outlining what treatment should be carried out in each of the four steps just mentioned. These are:

(1) The care of eye injuries is so specialized that almost all surgery should be done by an ophthalmologist.

(2) The care to be given by the "first aider" should be limited to the minimum.

(3) The care to be given by the initial physician should be limited to only necessary eye care and determination of which individuals should be seen by an ophthalmologist. Obviously, individuals with first degree eyelid burns, conjunctivitis due to thermal radiation, or irritation from foreign material should not be sent to the ophthalmologist since he will be overwhelmed by cases which really require his attention.

(4) No treatment outline is required for the ophthalmologist other than to impress upon him that he must do the greatest good for the greatest number and for this reason prolonged surgical procedures are not justified on eyes with little chance of successful outcome.

Initial Care. This will usually be rendered by the individual himself, by a member of the family or a member of a roving first aid team. Its objective should be—

(1) Prevention of further damage to the eye.

(2) Relief of suffering if required.

(3) Getting the patient to professional help.

Kuhn has stated regarding this phase that this should consist of

"1. Fill the eye with 0.5% Pontocaine in 1 to 3000 Zephiran—To relieve pain and prevent infection. (This to be available in single dose capsules for first aid personnel.)

"2. Tear a piece of sterile cloth from roll carried on the back of the first aid man and cover the eye.

"3. Pain of an eye injury (other than burns) is not great, therefore, hypodermic injection of morphine is not necessary."

Clark, Dunphy, Irvine, Post and Vail in their excellent article on "Initial Treatment of Acute Injuries of the Eye" state that initial care of ophthalmic casualties should be essentially those carried out in World War II. First aid men were allowed only "to remove superficial dirt and debris as gently as possible; cover the eye with sterile pads; instruct the casualty to keep as quiet as possible and under no circumstances to touch his eyes; and then to arrange for his evacuation, preferably recumbent, to an evacuation hospital."

These two above-outlined therapies are in essential agreement. The use of any tight dressing over the eyes at this stage is contraindicated because this group of treatment personnel are obviously incapable of determining presence or absence of a perforating eye injury. The use of Pontocaine may well prevent a lid spasm which might be disastrous in a perforating eye injury. Its use could probably be omitted with mass casualties if necessary without serious harm to most cases.

In addition there will be a certain number of individuals who will get chemicals of some type in their eyes. These should be irrigated with plain water if it is available.

It can be poured from a canteen, pan or bucket or the patient's eyes may be immersed in a bucket of water if necessary. This irrigation should be carried out as promptly as possible, with the lids held open, and should be continued for a minimum of ten minutes and preferably for twenty to thirty minutes if the patient's other injuries will permit.

Initial Professional Care. It is this phase of the patient care that presents the principal problem. This is true because most general surgeons and general practitioners have neither the knowledge nor the equipment to make an accurate diagnosis in eye injury cases nor are they capable of carrying out most of the procedure required in the proper care of injured eyes. Because of the shortage of ophthalmologists, however, and the fact that eye injuries will be associated with other head and facial injuries it is obvious that much of the early treatment and the classification of cases must be done by this group.

There are certain points which may be useful in this connection:

1. Any injured eye which is really painful is usually severely injured, burned or has a corneal abrasion. Absence of severe pain does not, however, rule out serious injury.

2. Change in pupillary shape with flattening of one border indicates an iris injury, usually with a tear at the iris root on the same side as the flattened iris edge. Change in pupillary diameter or failure to react to light is a frequent finding in a contused eyeball and should not be interpreted as an indication of central nervous system damage. Presence of blood, even the slightest trace, in the anterior chamber may be of diagnostic assistance here.

3. A conjunctival wound should always be suspected as an accompaniment of a deeper eye injury, either a scleral laceration or an intra-ocular foreign body. Repair of a conjunctival wound is of no value if there is a laceration and is not essential if there is no deeper wound.

4. Intra-ocular foreign body must always be suspected in any case with a lacerated globe, any hole in the iris, or hemorrhage in the anterior or vitreous chamber.

5. Intra-ocular hemorrhage, even slight traces in the anterior chamber is potentially dangerous to the future welfare of the eye. This is true because of the marked tendency for the hemorrhage to recur with serious increases in intra-ocular tension. For this reason these cases should all be seen by the ophthalmologist. Hemorrhage in the vitreous chamber produces loss of sight for the patient and inability of the doctor to examine the fundus with an ophthalmoscope or even to obtain a fundus light reflex.

6. When a foreign body is present or suspected in an eye it may first be gently irrigated with physiological saline or boric acid solution. Many foreign bodies will be removed in this manner. Most superficial foreign bodies on the cornea or conjunctiva can be removed with a wet cotton applicator. If the foreign body does not come out with two light passes, it should be left for the ophthalmologist. Intra-ocular foreign bodies are not emergencies and should only be attacked by an ophthalmologist when adequate diagnostic and treatment facilities are available.

7. Tetanus prevention measures are a requirement in all puncture, or perforating wounds and all intra-ocular foreign body cases.

8. Small slivers of foreign material extending through the coats of the eye should not be removed except by the ophthalmologist when he is prepared to handle the possible prolapse of ocular contents which may follow. Such cases should have both eyes lightly dressed to prevent eye movement and then taken to an ophthalmologist as promptly as possible.

9. Any patient with an intra-ocular injury should be evacuated as a litter patient if at all possible.

10. Any case of perforation of the globe should be evacuated as a litter patient.

11. Cases with lacerations of the lids should be repaired by an ophthalmologist. Failure to suture them carefully and in

proper layers results in deformities which because of their location on the face are of major importance to the patient. They should not be repaired by sutures extending through the full thickness of the lid because of subsequent injury to the cornea in addition to defective apposition. In all cases, however, the cornea must be protected from drying. This may be accomplished by pulling the lacerations together temporarily with silk sutures through the skin. Such sutures may also be used to pull the upper lid down to the lower lid, or in its absence, to the cheek. The lower lid may be sutured to the upper or to the brow in similar fashion. No tissue should be debrided unless it is definitely gangrenous. If there is insufficient lid tissue to cover the cornea a moist chamber should be utilized.

12. The proper dressing of eye injuries for transportation is important. In any severe injury both eyes should preferably be occluded to stop eye movement of the injured eye. If the patient must be able to see, an opaque disc with a pinhole placed before the uninjured eye will permit vision with little eye movement. It must be remembered, however, that such a patient cannot travel alone because of the restriction of his visual field.

The type of dressing over the injured eye will depend upon whether the lids are intact and whether there is or is not a perforation of the globe. If the lids cover the cornea and the globe is not perforated a light pressure dressing should be applied so the lid will not move over the globe and increase the injury. If however, there is a perforation, a firm dressing may well cause prolapse of ocular contents through the perforation. In such cases the dressing should be applied carefully to be sure no pressure is exerted on the eyeball.

13. Eye burns, both chemical and thermal will be painful and may require instillation of Pontocaine 0.5% (either drops or ointment) to control pain. This will delay healing somewhat and should not be done unless it is essential.

14. Prevention of infection in eye burns or injuries should always receive consideration. This is especially true when there is any corneal involvement since the cornea has no direct blood supply and is, therefore, susceptible to infection. Systemic antibiotics can be administered. Chloramphenical penetrates the eyeball somewhat better than others and should be considered if available. Penicillin is useful systemically in large doses as are the other usual broad spectrum antibiotics.

Local measures to prevent infection may be utilized after any chemical has been well irrigated for at least twenty minutes with plain water and any perforation of the globe has been sutured. (No eye ointments should be used in any eye which has a perforation or a poorly sutured wound.) Instillation of sodium sulfacetimide, 30% solution of 10% ointment, is useful as are the various ophthalmic ointments, Bacitracin, Aureomycin, Polymyxin, Terramycin, Erythrocin, Neomycin, etc. Because of its tendency to produce sensitivity, Penicillin should not be used locally.

15. Perforating wounds of the eyeball are the most critical problem because their treatment cannot be delayed. If it is delayed the loss of useful vision rises rapidly. These cases must be given first priority for ophthalmologic care. They can be recognized as those cases that have frank openings in the globe, those that have tissue protruding from the globe (including vitreous which resembles white of an egg) and those with loss of the aqueous from the anterior chamber. Flat anterior chamber is diagnosed by the dull appearance of the iris as it lies against the posterior surface of the cornea.

16. In severely injured eyes the tendency for some general surgeons is to do an immediate enucleation. This should be avoided to allow the ophthalmologist to make the decision. If general supportive, stimulating and antibiotic therapy is started the delay will not ordinarily endanger the patient's future welfare nor will it produce significant incidence of sympathetic ophthalmia if the de-

finitive therapy can be completed before 14 days after injury.

17. The principal duty then of the first physician who sees an eye case will be to:

(a) Remove any debris from the eye.
(b) Remove superficial foreign bodies.
(c) Remove chemicals from the eye.
(d) Treat mild burns of the eyelids and globe.
(e) Treat non-perforating injuries of the globe.
(f) Make the above patients comfortable, use measures to prevent infection, apply proper dressings and send them on their way.
(g) Recognize perforating injuries, make them comfortable, apply proper dressings and see that they get first priority for ophthalmic care.
(h) Refer severe burns, involving the globe, to the ophthalmologist as second priority.
(i) Refer severe lid lacerations to the ophthalmologist as third priority.
(j) Refer intra-ocular foreign bodies and contusions of the eyeball with or without intra-ocular hemorrhage and all other types of eye injuries requiring ophthalmological care as fourth priority cases.

Initial Ophthalmologic Care. This will require adherence to the priorities for treatment outlined above as well as assignment of priorities to individual cases for surgery. At this point also the controversial or questionable cases can be treated and nonessential cases can be eliminated from eye treatment facilities.

Definitive Ophthalmologic Care. This will ordinarily be carried out in hospitals where necessary specialized equipment will be available. The "greatest good for the greatest number" philosophy must still prevail and available effort put into the cases whose eyes can be saved while the near hopeless ones are deferred.

SUMMARY

1. In any nuclear attack there will be a large number of eye casualties. The care given these casualties will depend in large measure upon proper prior planning.

2. There are certain eye injuries in which delay in treatment can be tolerated without unduly increasing the risk to the vision of the patient. Contusions of the globe, vitreous hemorrhage, mild lid lacerations, first degree burns of the lids and intra-ocular foreign bodies are examples.

3. There are other lesions in which early care may produce a good visual result and late care may result in enucleation of the eye. These are the perforating injuries of the globe. These are the injuries which must be given first priority for evacuation and definitive treatment. There are other cases which in urgency lie between the lacerated globe and the cases which can be delayed. For this reason four priorities for treatment have been suggested.

4. It is believed there must be four categories of care also for eye cases. These are—

(a) Non-professional care given by the patient himself, or a "first-aider."
(b) Initial professional care given by a physician who is not an ophthalmologist.
(c) Initial ophthalmologic care given by the ophthalmologist who sorts the eye cases and establishes priorities for surgery as well as giving treatment to those in whom surgery is not required.
(d) Definitive ophthalmologic care in hospital.

5. The implementation of such a plan calls for the training of people, the acquisition of supplies and equipment, the storage of such supplies and equipment in the proper places and the fitting of people into an organization so the plan can function.

Summary and Discussion of Medical Effects*

By
MAJOR GENERAL JAMES P. COONEY, MC
The Deputy Surgeon General, U. S. Army

THE papers presented this afternoon have represented an introduction into nuclear weapons phenomenology and medical effects resulting from these phenomena. Certainly it is obvious that the surface can only be scratched when dealing with effects of such magnitude in such a short discussion period but I think the material covered may very adequately lay the ground work for tying in the subject matter to follow with the characteristics of nuclear weapons.

To apply concepts of management, in such a way as to make them valid for the special case, is well nigh impossible since the scope of any special case will depend upon weapon yield, height of burst, method of delivery, degree of warning, the weather conditions prevailing at the time and for several hours following, and the location of the burst with respect to population. Therefore, the aim here must be to generalize on the effects in such a way as to assist our planners in arriving at a flexible overall scheme which may be adaptable to any situation. With such a generalized plan, the commanders with their technical advisors both medical and otherwise, can intelligently cope with the impact to their organization.

Detailed knowledge of effects giving precise estimates of damage radii for the various effects are essential for exploiting them in offensive use of the weapons. However, from our standpoint which is mainly defense planning, we know not the time nor place of the detonation and therefore cannot apply the technical computations to assist us. It is this fact which necessitates our striving for a universal general knowledge of effects and a well integrated plan to meet them.

In summary then we have a weapon capable of instantaneously producing blast of an unprecedented magnitude, heat greater than the sun, and radioactivity thousands of times greater in quantity than could be dreamed of by industrial production standards. Associated with these phenomena will be casualties of a variety and number to create a problem taxing the ingenuity and capability of all components both military and civilian. Medically, the problem certainly embraces just about all the specialities within the fields of medicine and surgery and the solution of this problem will be forthcoming only with a sound approach based upon a generalized fundamental understanding of the forces at work and their effects upon the populace whether it be military or civilian.

* Presented at the 62nd Annual Convention of the Association of Military Surgeons of the United States held at Washington, D.C., November 7-9, 1955.

PRINCIPLES OF CARE OF MASS CASUALTIES*

Introduction to Principles and Objectives

By
JOHN B. HOZIER, M.D.†

I AM SURE we would all agree that in peacetime the art and science of military medicine are very much like that of civilian medicine. Both communities have the same diseases and accidents, and the diagnosis and treatment are largely the same for each. It has been through the collaborative efforts of military and civilian physicians and their components of the paramedical services that such great strides have been made in the advancement of preventive medicine, trauma, and the management of mass casualties.

During wartime, large, opposing armed forces use many varieties of destructive agents capable of causing vast numbers of human casualties. As a result, the practitioners of military medicine have found it necessary to develop certain doctrines and methods to perform effectively and efficiently the medical management of the continuing flow of surviving casualties. In military medicine are heard common, every-day expressions such as triage, teamwork, evacuation rearward, debridement, delayed primary closure, definitive care, restoration, and reclassification. It should be recalled here that the key word is *triage* or sorting which is a continuing activity at each echelon of medical management. When the medical resources available suddenly have the responsibility for large numbers of casualties, priorities must be designated if the largest number of lives and limbs are to be saved and the greatest number of men returned to duty rapidly to carry out the military mission. It has been emphasized that all military personnel are part of a team, each person performing his duties all too frequently with the imposition of very strict limitations on the available resources.

Because of these realities, through the years, certain surgical and medical doctrines have evolved in military medicine which have proven during more recent wars to be effective in reducing the morbidity and mortality rates. With the concept of thermo-nuclear warfare and the masses of traumatic casualties which will occur, familiarity with these doctrines and the importance of the recognition of teamwork become more highly significant than ever before. Under such conditions, the concept of triage plays an even greater part, and there will be little time to correct errors in judgment or to avert the penalties which must follow such errors. All medical management must be directed toward the good of serving the greatest number with resources which will most often be critically deficient. It will become our objective to devote the limited medical means to those people in need of more simple life-saving procedures and first aid measures which will assure early return of the greatest number to productive capacity. In the beginning, at least, the injured who are in need of complicated procedures requiring relatively long periods of time will have to be deferred. It should be emphasized that whereas no casualty is to be considered abandoned, concentration of medical effort on the few denies appropriate care to the many.

Mass traumatic casualties will result from the effects of blast, flying missiles, and burns. Other types of casualties could result should the enemy use biological warfare, chemical warfare, or weapons producing radiation exposure.

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† Medical Director, USPHS. Chief, Health Emergency Planning, Office of the Surgeon General, U. S. Public Health Service Dept. Health, Education, and Welfare, Washington 25, D.C.

Very recently the medical problems of mass disaster from natural causes have been experienced by several of our civilian communities. Though on a much smaller scale than those coming as a result of wartime conditions, they are severe enough to point up serious deficiencies in planning, organization, and training for effective medical management.[1]

You will all agree, I am sure, that there can be no more important role in disaster operations than the care of mass casualties. The work of this organization and the entire field of military medicine have proven the value of the need for planning, organization, and training for the management of mass casualties, if indeed any proof were needed.

Yours is an extremely important part of the total defense system against disaster, whether natural or man-made. We are fortunate, indeed, that groups such as yours are alert to their responsibilities and, through sessions like these, are actively engaged in exchanging ideas and experience and broadening their horizons. This is our best assurance of a calm and orderly and effectively organized approach to any emergency situation which our Nation may be called upon to face.

[1] "Professional Care of Casualties" by Col. Joseph R. Shaeffer, M.C., Chief Surgical Consultant, Office of The Surgeon General, Department of the Army.

Protective Measures in Nuclear Warfare*

By

LIEUT. COLONEL S. E. LIFTON, USAF (MC)†

I INTEND to discuss the means by which we in the military, by taking comparatively simple measures, can protect ourselves from the effects of a nuclear detonation, and in a short time following such an attack, can become operational in order to fight back.

With the advent of nuclear warfare, a multitude of new problems has arisen to challenge both the military and civilian populace. We in the military have the more difficult problem. I believe all of us know the basis of these problems—i.e., blast, thermal, and radiation, both prompt and residual radiation, or the so-called "fall-out." The military must be prepared to face these hazards and to remain operational with the most efficiency and with a minimum of effort in terms of time, money, and manpower. I propose to show how this can be accomplished.

First, let us look at the facts. The first two nuclear bomb hazards, blast and thermal, are nothing new to the military. We have learned to cope with these in the past. Ionizing radiation is the comparatively new hazard, which had been anticipated. However, following early tests, both in the Pacific and Nevada, this bugaboo of ionizing radiation didn't materialize due to the fact that air tower bursts were utilized and those personnel who would have been in a position to receive appreciable doses due to ionizing radiation would have been well within the lethal zone of blast and thermal damage. Consequently, radiation was considered to play a minor role, and thus its study was deemphasized in 1951.

We rolled along in this belief until March 1954, and I'm sure you all know what happened on that date. A thermonuclear device was exploded on the surface of Bikini and we were back in the radiation business. Without going into classified details—natives, as well as members of the Armed Services, were subjected to fall-out. If this were a combat situation, and if these personnel were not evacuated, they would have become combat non-effectives. In addition, there was a Japanese fishing vessel in the vicinity, and this fishing vessel received fall-out. As a result, one of the Japanese fisherman has since died, certainly as an indirect result of ionizing radiation. The exact distances from detonation of all of these personnel is unimportant. Suffice it to say that none of them were in the direct downwind pattern, which would have been the worst possible condition. As the newspapers reported, an area of several thousand square miles was covered with a lethal amount of radiation, and many of the personnel in this area might have died if no action had been taken.

Now let us get into the actual features of *protection against nuclear attack*. The three services all have different problems, but essentially the basic principles will be the same.

Blast injuries result from debris such as bricks, cars, buildings, poles, or portions thereof, being hurled at the individual; and on occasion the individual may become a missile himself, being hurled at high velocities against an immovable object. If the individual is standing in an unprotected site, he presents a comparatively large surface as a target. The simple expedience of falling prone upon the ground will reduce the target area presented. As we place the individual further and further underground, the chances of blast injury become less.

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Thermal injuries occur in one of two ways . . . flash burns and secondary burns. The flash variety occurs as a result of the thermal impulse from the fireball itself. Secondary burns occur as a result of fires which have been started by thermal radiation. Thus, the individual's clothing may catch fire, causing secondary burns . . . or the entire area in which the individual is caught may catch fire causing burns to the individual trapped within this area. Any sort of material interposed between the individual and the fireball will help protect against flash burns. Thus things like clothing, buildings, and dirt will offer protection. Trash, such as rags and paper with a low ignition point, will catch fire easily. Thus, it can be readily seen that the policing of an area would aid in removing combustible material. Fire storms resulting from a nuclear detonation require fuel to keep going. If no fuel is available the fire storm cannot get a start. Large clear areas between built-up areas would keep fire storms from spreading. Thus, dispersal of areas, with clear spaces interposed, would aid in keeping down injuries due to secondary fires.

Actually the best method of protection is simply not to be there. In so doing, we escape the blast and thermal. But what of ionizing radiation? Do we escape this? The answer is no, depending upon how far we have evacuated, the wind direction, and whether an enemy has been considerate enough to drop only one bomb. If multiple bombs are dropped, we may be walking from the frying pan into the fire—in other words, directly into the path of the fall-out of another bomb detonation. At any rate, evacuation laterally may be one means of protection, but this must be predicated upon sufficient warning.

A second method is to evacuate vertically upon warning, either upward or downward. Upward by means of aircraft, or downward into basements or trenches. If your vulnerability studies indicate that your facility is a primary target, perhaps evacuation in a lateral direction and then vertical evacuation downward when you reach your destination would be best—for a direct surface hit on your installation with a megaton weapon will destroy your installation and its personnel even though in basements. However, if your installation is not a primary target in its own right, it still could be knocked out by the effects of radiation, just as though it had received the bomb itself. Nevertheless, by the simple expediency of getting into a basement, if available, or a slit trench if basements are not available, you can escape the lethal doses of ionizing radiation. It is suggested that the equivalent of two to three feet of dirt will suffice, but a cover on the trench, if you so desire, will help. Even this is not necessary, for it is not the comparatively small amount of fission products falling on you that is killing you; it is the sum of all the fission products for a 300-foot radius around you that is doing this.

Doubtlessly, many of you have read the articles in our newspapers and magazines which state that one must remain in such a shelter for a week or weeks before daring to come out. How can we remain operational under such circumstances? First, let me state that if your installation is close in to the area of destruction, and, in addition, in the direct downwind area, this is probably true. However, in the majority of instances your bases will not be so oriented that they are both close in and downwind. In other words, if I may be permitted to use the term, the "average military installation" will not receive fall-out of the magnitude suggested by these news releases. Secondly, the premise of remaining in shelters for long periods of time is predicated, I believe, upon getting out and receiving only AEC tolerance doses. During wartime we will have to accept much higher doses in order to fight back. How long then must we remain in such shelters on the "average military installation"? Due to the rapid decay of fisson products, we must remain in these shelters only a matter of hours before limited emergency operations can begin. This means that if there is a necessary job requiring several hours work to perform, we may remain in shelters for a period of hours following onset of fall-out, come out for a period of hours, complete our task,

and get back into our shelters without lethal or incapacitating dosages being received.

To use a concrete example, in the Air Force, if the mission of the base calls for aircraft to take off, and if it is deemed impossible to do so before active fall-out begins, this base can go underground during the active fall-out phase for a period of several hours. Following this, support personnel necessary to prepare the aircraft for take-off can go above ground for a period of several hours in order to prepare these aircraft, following which they will immediately return to their underground shelters. The aircrews in the meantime have remained in these shelters until the aircraft are ready to be manned. Thus the mission of the base can be accomplished with comparatively little delay, despite fall-out.

Every installation will have to determine the actual hazard in each specific instance in order to take appropriate and necessary action.

I should take a moment here to mention radiac equipment. Even if a specific base has not been hit by a nuclear detonation, this base must nevertheless have proper radiac equipment to detect that fall-out is occurring before proper protective action can be taken. In addition, it is necessary to have personnel trained to read these instruments so that they can determine the eventual peak that will occur by the steepness of the slope of the reading on the radiac instrument—and therefore, advise the commander as to actions which should be taken.

In view of the foregoing, let us examine the question of decontamination. As I have attempted to show, we must seek shelter for a comparatively short time, measured in terms of hours, following which emergency procedures can take place. Is decontamination, therefore, necessary or worthwhile? The answer in most instances, I believe, is no. Decontamination during the critical few hours when we must remain in shelters would be of little value, for while we are decontaminating, fall-out is still coming down. We would have much the same situation as an individual attempting to clean his sidewalk while the snow still falls. Decontamination following cessation of fall-out, as has been explained previously, is not absolutely necessary due to the fact that decay takes place so rapidly that we can begin emergency operations shortly after completion of active fall-out. I am not saying, "Do not decontaminate." However, what I am attempting to say is that decontamination should have a low priority under normal circumstances, and if time and manpower are available, then decontaminate. But it appears as though there will be more important work to be done and in such instances decontamination should not interfere with the performance of other necessary duties.

The Navy has preached and is still preaching decontamination. I believe the Navy has a valid reason for this belief. To begin with, the Navy has a comparatively small area aboard ship that can become contaminated. In addition, most Navy vessels are equipped with excellent pumping facilities, an inexhaustible supply of water, and a sewage system which is unsurpassed. Decontamination for the Navy, I believe, is not only feasible but advisable.

How does all this affect the medical service? To begin with, we in the medical service can use all the aforementioned methods of protecting ourselves and our patients during and following a nuclear attack. Basements must be provided for our medical personnel and patients. In event that basements cannot be provided, slit trenches will do for ambulatory patients and medical personnel. In the latter case, sandbagging of the first floor of a small area of the hospital in which all bed patients must remain would aid greatly in protection against fall-out.

You have been told or will be told that the first few hours following attack are the critical ones from the standpoint of treatment of casualties—which means that in order to save the maximum number of lives the medical service should attempt to receive and give first aid of a lifesaving nature within the first few hours following detonation. At

the same time, you have been told that these are the critical hours when all personnel must protect themselves by remaining in some sort of shelter. I am afraid that the medical service in a fall-out area under the conditions of a large-yield surface detonation must remain in these shelters, for if they attempt rescue procedures and casualty treatment, those medical personnel would become casualties themselves. In addition, under the aforementioned circumstances of a large-yield surface detonation, even if fall-out were disregarded by the medical service, by the time aid could be given, direct casualties would undoubtedly have received superlethal doses of ionizing radiation. Therefore, I would like to throw out the following statement for your consideration. In my opinion, and this is strictly a personal opinion, following a large-yield surface nuclear detonation, only those casualties who can come out of a disaster area under their own power or with the help of buddies stand any chance of survival. I would like to emphasize that I am not speaking of air bursts. In these instances many lives can be saved by rapid, efficient utilization of the medical services.

In summary, I would like to state that, if we are in the zone of destruction from a surface-detonated weapon, there is very little that one can do to protect himself except by not being there. We can readily protect ourselves from the bonus effect of the bomb, namely the "fall-out," by evacuation in the vertical plane, either upward or downward. Vertical evacuation downward would also protect against blast and thermal, and indeed prompt radiation from an air burst. In other words, basements or trenches, or any underground shelter will protect against almost every effect of a nuclear weapon, unless you happen to be unlucky enough to be at or very close to ground zero.

I would strongly recommend:

1. That each fixed military installation, now existing or to be built in the future, have sufficient basements—the deeper, the better—to act as shelters for all personnel present on the base.

2. That underground shelters be built on existing bases which do not already possess them.

3. That, in lieu of the above, slit trenches six-feet deep be dug.

4. That each base have the proper radiac instruments and the personnel trained to interpret these instruments.

5. That any contemplated evacuation laterally with warning must terminate in an underground shelter.

6. That more medical service personnel be trained in this field.

I believe all the foregoing can be done cheaply, efficiently, and will result in maintaining our military capability following nuclear attack.

Casualty Estimates in Nuclear Warfare*

By

LIEUT. COLONEL ARTHUR STEER, MC, USA†

IT IS essential that a simple and rapid method be available which will indicate with reasonable accuracy the number of injured requiring medical care in any area subjected to a nuclear weapon attack. This method of calculation must not depend on unavailable information such as the yield of the weapon or the height of the burst. It must not require the services of specialists such as mathematicians or nuclear physicists. Further, most of the information required for the calculation should be gathered before the attack and the little information required after the bomb is detonated must be obtainable easily, rapidly, and accurately. In order to make the necessary calculations, one must know weapon effects and certain facts concerning the population exposed to those effects. Briefly, let us review these factors.

Nuclear weapons produce radiation, blast and thermal effects which vary in severity with the yield of the weapon, the height of the burst, and atmospheric conditions. However, within certain definite limits, these effects bear a fairly uniform relation to each other so that if one can be measured, the others may be estimated.

Within the time at my disposal, I cannot discuss prompt and delayed radiation effects other than to say that with an air burst, these do not seriously increase the immediate medical problem. Others will discuss radiation effects following a surface or sub-surface burst.

Detonation of a nuclear weapon produces a blast wave which at first travels very rapidly but soon slows to the speed of sound. The magnitude of the blast wave is measured in psi (pounds per square inch) over pressure (above normal atmospheric pressure). A pressure of 15 psi will destroy and level all structures except reinforced concrete earthquake resistant buildings. Injuries and death result from the innumerable secondary missiles torn from the collapsing buildings. In addition, individuals may be thrown at rigid structures. As is true for the other effects, the magnitude of the pressure forces decrease very rapidly at first and then are dissipated more gradually (Fig. 1). Consequently, there is a relatively abrupt transition from the area of complete destruction (15 psi or more) to the zone of moderately severe destruction (below 15 psi) and the zone of complete destruction is recognizable and measurable by an airborne observer.

The thermal effects of nuclear weapons travel with the speed of light and in a straight line. Because any substance having a shadowing effect also has a protective effect, one talks of flash burns produced on the exposed surface of the body which the "bomb can see." Atmospheric visibility is an important factor and determines the size of the area of the thermal effect. On a clear day the bomb can see further, can burn individuals in a larger area than when visibility is limited (Fig. 2). Severity of the flash burn is related to the caloric equivalent of the thermal effect; above 8 calories per square centimeter, third degree burns are produced and between 8 and 3 calories per square centimeter, second degree burns are found. An unprotected and completely nude individual facing the bomb would receive flash burns on 50 per cent of his body.

Conventional secondary burns may result from ignition of clothing or of structures. No attempt is made to estimate the possible effect of fire storms and conflagrations on the medical load, but it should be noted that in omitting this calculation, the theoretical medical load is maximized because injured

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individuals trapped in such wide-spread fires could not be rescued.

To calculate casualties, it is necessary to know the population density in the area attacked. A bomb will injure more people in a large city than in a small city. Where people are crowded together, more will be injured per square mile than where people are dispersed. The type of structures and habitations is of importance. Considerable protection is given by reinforced steel and concrete buildings, and relatively little protection by frame buildings. The time of day is of importance. An attack during daylight will find many more individuals out in the open where they can be seen and burned by the bomb. In the winter, people are more heavily clothed and therefore have greater protection against thermal effects. There can be a considerable decrease in the medical load if even a few minutes of warning is given. If the population has only time to get within shelters and thus avoid the thermal effects, there is an appreciable decrease in the number injured and a marked decrease in the number burned. It is necessary to know something about the habits of the population. Is there a concentration of

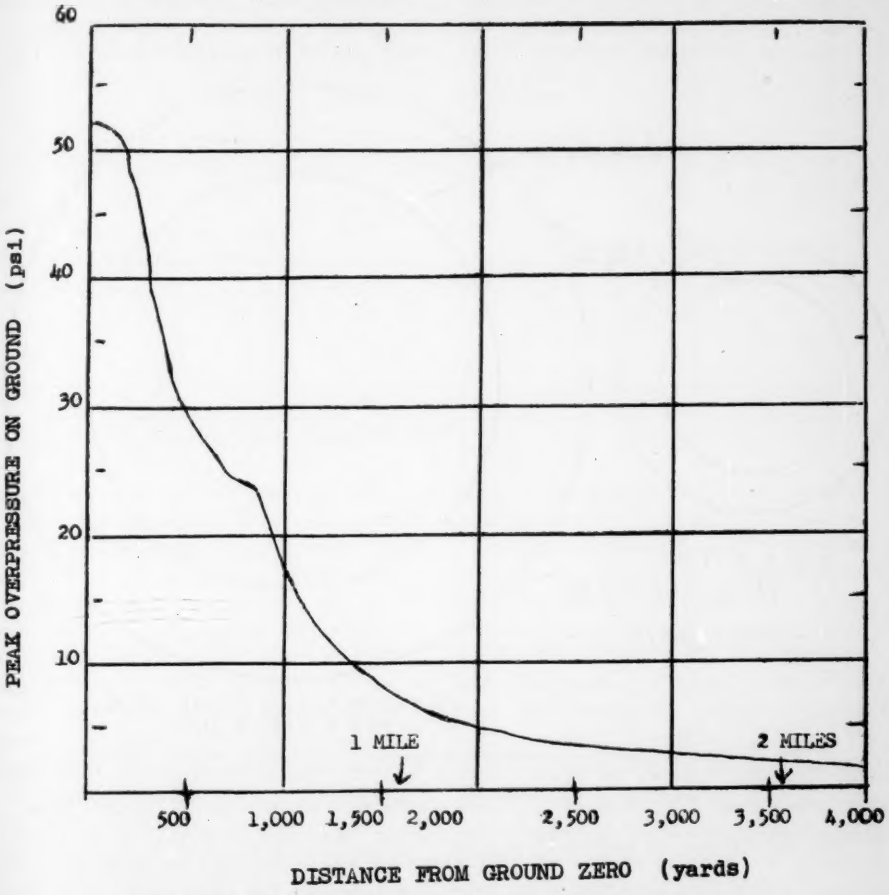

FIG. 1. Rate of decrease of overpressure in distance from ground zero.

workers in the center of the city? Does the majority tend to be out of doors during the day time?

Before the method of calculation is described, it must be noted that three assumptions are made. First, that there has been some prior planning and that the individual making the calculation has accumulated information concerning the population in the area. Even now, Civil Defense and area damage control officers are gathering this information for their areas. Second, that a method for immediate inspection of the damaged area has been prepared. Simple inspection from a light plane or helicopter by an observer instructed to determine four fundamental features is all that is required. These are: a) the presence or absence of a crater; b) the location of the center of bomb damage; c) the diameter of the zone of complete destruction, and d) visibility. These features are easily determined from the air.

The third assumption is that casualties refer to all the injured still living one hour after the detonation. There is no implication that all of these will be rescued alive or that all will require hospitalization. This, therefore, represents the theoretical maximum medical load.

Accepting these assumptions, calculation of casualties becomes a simple process by using one of four applicable tables. This table may be used as an example Table I. First, notice that nowhere is there mention of the size of the bomb or the height of the burst. Second, this table applies to an urban community when the visibility is approximately 10 miles. Third, factors are presented separately for a situation where no warning is given and when there is warning. These factors are in per cent of the population and are divided among "killed," "injured," and "uninjured." Next one finds the headings of five columns. The first two are actually the same, the first being the radius of the zone of complete destruction in miles as reported

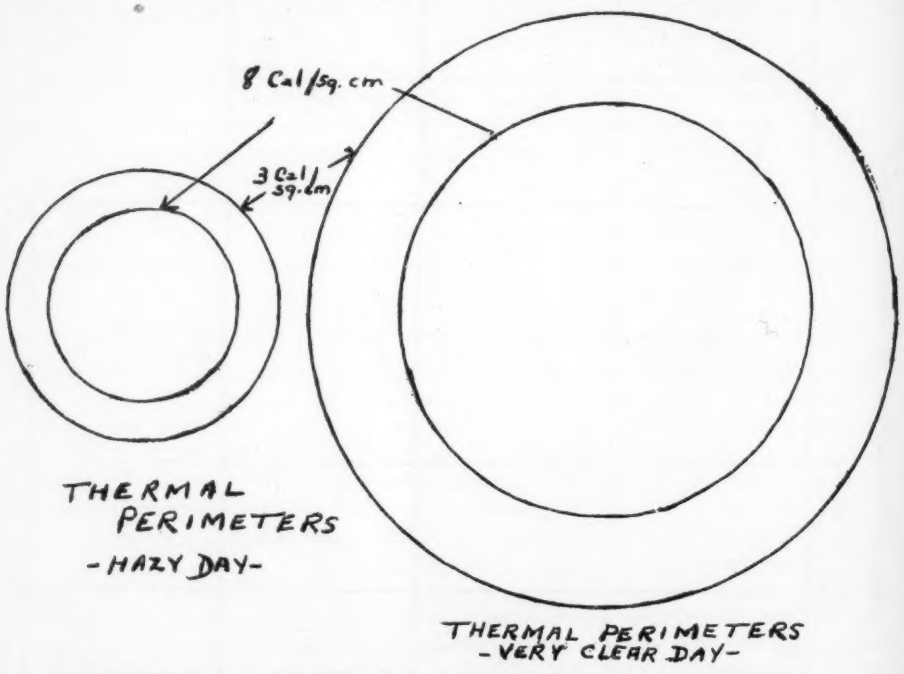

FIG. 2. Effect of atmospheric conditions on thermal radiation of the nuclear weapons.

TABLE I. CASUALTY CALCULATION FOR AN URBAN COMMUNITY ON A CLEAR DAY

Urban Communities		10 Miles Visibility			
Effects		Zone I	Zone II	Zone III	Zone IV
Pounds per Square Inch		*35–15	15–10	10–5	5–2
Calories per Square Centimeter		*1000–40	40–10	10–8	8–3
		%	%	%	%
Unwarned	Killed	90	60	35	10
	Injured	10	30	50	30
	Uninjured	0	10	15	60
Warned	Killed	90	50	20	0
	Injured	10	35	55	10
	Uninjured	0	15	25	90
Radius, Zone of Complete Destruction in Miles		Area in Square Miles			
0.4		0.5	0.3	0.3	2.7
0.6		1.1	0.7	0.7	6.6
0.8		2.0	1.1	1.4	10.7
1.0		3.1	1.7	2.2	15.8
1.3		5.3	2.7	3.3	25.0

* Much greater than 35 and much greater than 1000.

by the air observer and coincides with the second column which gives the area in square miles which receives blast effects greater than 15 psi. At ten miles visibility, the thermal effects in this area are greater than 40 calories per square centimeter. The next column gives the area where blast effect ranges from 15 to 10 psi which will cause severe damage to all but reinforced structures. The fourth column gives the area where over pressures range from 10 to 5 psi, causing moderate damage to buildings. The last column gives the area where over pressures range from 5 to 2 psi causing collapse of wooden structures.

This table can be constructed because the areas of destructive effects maintain a fairly constant relation to each other. If the radius for the first zone, the zone of complete destruction, is known, the other areas can be determined. Because the size of the area of complete destruction will vary with the yield of the weapon and the height of the burst, the table gives areas of different sizes for various combinations which may be expected from any size weapon detonated as an air burst.

Since the population density is assumed to be known, it becomes a simple matter to determine how many people were in each area at the time of detonation by multiplying the number of inhabitants per square mile times the number of square miles in each area. The number of "killed," "injured," and "uninjured" in each area is then determined by using the applicable percentage factors at the head of the table.

These percentage factors deserve examination. They were derived first by estimating the amount of destruction in the various zones of several cities. Then the probable effect on individuals in these areas was studied. Experience tables from the cities in England, Germany, and Japan in World War II and battle experience from other wars were considered. The effects of the bombs over Hiroshima and Nagasaki and of the test weapons in the Pacific and the Nevada proving grounds were studied. The distribution of injuries produced and sever-

TABLE II. CASUALTY ESTIMATION IN A CITY OF 50,000 FOLLOWING A NUCLEAR WEAPON DETONATION WITHOUT WARNING ON A CLEAR DAY

	Zone I	Zone II	Zone III	Zone IV	Total
Area (Sq. Miles)	1.1	0.7	0.7	6.6	9.1
Population	5,500	3,500	3,500	33,000	45,500
Killed	4,950	2,100	1,230	3,300	11,580
Injured	550	1,050	1,750	9,900	13,250
Uninjured	0	350	520	19,800	20,670

ity of burns in the various zones were considered. Finally, the medical opinion of a large number of physicians was consulted. The percentage factors therefore represent a consensus and are in fact an educated guess of the probability of occurrence of death and injury in various situations. Thus, in the central zone of complete destruction, it is believed that the destructive forces will be so great that 90 per cent of all inhabitants in the area will be killed and all who survive will be seriously injured. Further, it is believed that the forces are so great that warning will not alter these percentages. However, in the second zone, it is estimated that without warning, 60 per cent will be killed, 30 per cent injured, and 10 per cent uninjured while with warning, these factors are changed to 50, 35, and 15 per cent respectively. Thus, beyond the central zone, warning has the same effect as moving the population away from the bomb.

Let us take a typical small city of 50,000 population covering an area of 10 square miles. Let us assume an even distribution of this population (5000/sq. mile), and that a nuclear weapon was detonated without warning over the center of the city on a clear day in spring when twenty-five per cent of the population was out of doors. The air observer dispatched to the scene within 15 minutes reports a central zone of destruction approximately 1.3 miles wide (radius equals 0.65 miles). Referring to Table II, we find that in this city under these circumstances approximately 12,000 will be dead and 13,000 injured one hour after the detonation.

Many of you will recognize that I have taken for my example a nominal weapon. We have been told that much more powerful weapons are freely available. A weapon only 20 times as powerful detonated as an air burst would contain almost the entire city within its central zone. Horrible as it is to contemplate, this would decrease the medical load. Study of the problem indicates that no situation is probable where more than 50 per cent of a population would be injured and alive one hour after the detonation of a nuclear weapon.

This discussion has been limited to an air burst situation where there would be no fall out or delayed radiation effects. It should be mentioned that most patients who will develop fatal radiation sickness will not require medical care during at least the first 24 hours after detonation of the bomb. Further, during this time the number exposed cannot readily be calculated because exposure data can only be obtained by monitoring a large area. In addition, unless one assumes good control of the population, early recognition of the dangerous areas, and an efficient rapid means of disseminating this information, one cannot estimate the number of individuals who will enter contaminated areas and received dangerous levels of radiation.

In summary, a Civil Defense or area damage control officer can rapidly determine the maximum medical load shortly after an air burst of a nuclear weapon provided he is acquainted with the area, has collected certain population data and obtains a minimal amount of information from an air observer. With this information, the number of injured can be estimated and the medical management of the large number of casualties can be conducted on an intelligent and informed basis.

Initial Aid and Rescue*

By
JOHN M. WHITNEY, M.D.†

YOU have been told what great numbers of casualties we might expect as a result of an attack with nuclear weapons. The important point is that thousands of casualties will be produced in a matter of seconds. Immediate casualty services will have to be provided locally, largely by nonprofessional personnel under adverse conditions, such as limited transportation, communications, supplies, and facilities. Under these conditions, successful casualty services will require the best possible advance planning, organizing, and training.

From experience gained in handling large numbers of casualties in military situations and in civilian disasters, certain basic concepts have emerged. Those are:

1. Time is an important factor. The longer medical care for a seriously injured casualty is delayed the less his chance for recovery. The system should be organized so that immediate first-aid can be provided through self-help, neighbor-help, and teams from first-aid stations.

2. Casualties must be transported carefully and quickly to the nearest medical facility for further management by skilled personnel.

3. Skilled medical personnel, with essential diagnostic and therapeutic equipment, should be brought as close to areas having casualties as circumstances will permit.

4. Initial medical and surgical supplies and equipment must be available immediately, and large reserve stocks ready for movement into areas that have suffered damage.

5. The magnitude of the supply needs demands uniformity in the management of specific types of injuries.

6. Adequate transportation will be required to move casualties from a disaster area to first-aid or clearing stations and then to local and distant hospitals.

7. Communication between casualty service units is a prerequisite to an orderly movement of casualties and supplies between facilities.

8. Administrative services to provide food, shelter, clothing, supplies, equipment, and personnel replacements are essential to efficient operation.

The first care of an injured person starts with self-aid, assistance by family members, neighbors, "buddy-help," or help from anyone who is near. In the recommended pattern of casualty care for the civilian population are included the other civil defense services most likely to be on the scene first. These are the warden, police, fire, and rescue services—all of whom should have had first-aid training. We recommend, of course, standard first-aid training for everyone from Cub Scouts on up.

Since the saving of many lives and limbs will depend upon the proper and prompt application of emergency medical care *all* personnel should be trained in life-saving first-aid procedures. This training should include: (1) Application of dressings; (2) Control of hemorrhage; (3) Emergency splinting of fractures; (4) Handling of the injured; (5) Artificial respiration and maintenance of upper airways; (6) Emergency care of certain wounds, such as sucking wounds of the chest and jaw injuries.

Skilled medical personnel should not be used for first-aid and rescue operations. Their limited availability in relation to the size of the medical load demands that they be used only in medical treatment facilities.

The organized phase of civil defense

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casualty services begins with roving or field first-aid and litter-bearer teams working out of first-aid or clearing stations that would be set up around the periphery of the damaged area, as close in as possible.

Personnel of first-aid stations would provide initial treatment for casualties. Field first-aid teams, followed by litter-bearer teams, would enter a damaged area to give aid to injured persons where they are found. They would assume responsibility for casualties receiving on-the-spot aid by neighbors, wardens, or other civil defense personnel. Walking casualties would be directed and litter cases would be carried to collecting points or directly to first-aid stations. From collecting points, they would be transported by ambulance to first-aid stations. When we use the term ambulance we mean any available vehicle.

All casualties would be routed through first-aid stations, or as directed by the first-aid station leader. Following sorting at the first-aid station, ambulatory casualties would be treated and discharged. Non-ambulatory or seriously injured casualties would be given initial professional care in stations and then transferred to existing or improvised hospitals, according to the judgment of the sorting officer.

Specific functions of the first-aid stations are:

1. Receiving casualties.
2. Sorting and classifying casualties according to nature and severity of injuries.
3. Decontaminating casualties.
4. Administering first-aid and giving initial professional care.
5. Preparing, maintaining, and transmitting appropriate records and reports.
6. Routing of casualties.
7. Maintaining medical and surgical supply support of all first-aid system groups.
8. Coordinating in the field, first-aid services with those of other civil defense activities.
9. Later, serving as outpatient stations for the follow-up care of sick and injured people.

The initial professional care to be given in the first-aid station should include but not necessarily be limited to:

1. Arrest of hemorrhage.
2. Giving of plasma, serum albumin, plasma expanders, or Group O whole blood.
3. Relief of pain.
4. Dressing of wounds.
5. Repair of minor lacerations.
6. Immobilization of fractures.
7. Giving tetanus prophylaxis, antibiotics, and other medications.

The use of narcotics should be held to a minimum; we subscribe fully to the principle that nothing should be done to a casualty that will decrease his capacity to care for himself.

Sorting and Classification of Casualties*

By

LIEUT. COLONEL JAMES B. HARTGERING, MC, USA†

PREVIOUS speakers have emphasized the relative magnitude of the medical problem that may result from the use of nuclear weapons. Predictably, during the early post impact period there will be a wide disparity between the size of the medical problem and the total surviving medical resources (personnel, facilities and supplies) that will be available for the immediate care of the injured. This estimate of the situation is the basis for my discussion of the principles of medical sorting and the classification of casualties.

Sorting is not a new concept. It has been practiced on the battlefield since the first combat casualties were attended by physicians. Army SR 320-5-1 defines sorting or triage as the process of sorting the sick and wounded on the basis of the urgency and type of condition presented, so that they can be properly routed to medical installations appropriately situated and equipped for their care. This definition is applicable to combat casualties under the usual battlefield conditions, and implies optimum as well as available medical care for all sick and injured individuals. Within the scope of this definition, on the spot clinical decisions are made designating those individuals who:

(a) Can be returned to duty after immediate medical care.

(b) Require further treatment in the area but are assured of an early return to duty.

(c) Require evacuation for prolonged or special treatment not available at local medical facilities.

It is well known that failure to accomplish timely and effective sorting will not only result in an unnecessary drain on the available fighting manpower, but may overload the medical evacuation and hospitalization system thereby delaying essential medical care for those individuals whose clinical condition requires prompt treatment. Sorting is a dynamic continuing process performed by each medical officer who treats the sick and injured throughout the medical service. It starts with the initial medical care and ends with final disposition of each patient.

Sorting of patients in conventional combat as just described is an exacting and critical procedure, but when confronted with mass casualties, it becomes even more difficult and demanding. Studied analysis shows that initial sorting is the key to the management of mass casualties. It must include not only the grouping of patients according to type and seriousness of injury in order to establish evacuation and treatment priorities, but for practical reasons must merge with the administration of emergency care in the preparation for evacuation. Fundamentally, sorting must be directed so as to assure the greatest benefit from the available resources for the largest number of patients. The group approach is basic to the management of mass casualties. Nevertheless, to accomplish the objectives, individual decisions must be made for each patient weighing the likelihood of survival, the time required to perform the necessary technical procedures, the cost of delay and the over-all capabilities of medical care available at the time. These features sharply distinguish disaster medicine from private practice as we know it in the United States today. In the latter, individual patient requirements are paramount since sufficient medical facilities are available to assure maximum benefit for all patients. In the treatment of mass casualties, by definition, there are insufficient medical facilities to assure maximum benefit for all patients. The

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group approach as it differs from the usual medical practice of priority treatment for all, the lightly injured as well as the most seriously wounded, has been and will continue to be difficult for any medical officer to accept unless he understands the magnitude of the problem. Critical and humane appraisal of alternatives clearly demonstrates that any other solution is both unrealistic and misdirected. In fact, it would not be in keeping with the best practice of disaster medicine; that is, saving the most lives and preserving the most function under the exigencies of the situation.

Viewed professionally, effective sorting requires medical officers possessed of good clinical training and gifted with mature sound judgment. They need to be capable of making a rapid evaluation both of what they see and what is to be done for each patient. Their decisions must reflect the calculated risk of delay in treatment in acceptable terms of increased morbidity and mortality. They must assess the urgency and degree of essential emergency care against the available evacuation means and the supporting medical capabilities. They cannot arbitrarily sort, treat and evacuate. There must be a place to which to evacuate. A suitable means by which to evacuate is required and the patient must be prepared for evacuation. All these factors will vary with the place and the occasion. The sorting officer will be required to vary his operations according to the existing problem.

Although sorting is performed at all levels of medical care, it is of prime importance at the first medical facility which receives and treats casualties as they either walk or are carried out of the disaster area. The major initial effort of the supporting hospitals will be governed by the ability of the forward stations to properly select and prepare those patients for evacuation who can be expected to benefit most from the immediately available surgery or other hospital type care. In order to visualize the principles, let us consider a single sorting or medical aid station located at the periphery of a disaster area. The organization and staffing of this unit will be discussed in a later paper. For the purposes of illustration, let us assume a patient flow that will process some 1,500 cases in the first 36 hours. The walking wounded will arrive first, and these will be followed by the more seriously injured. Figure 1 demonstrates estimated time and rate of the flow. The requirements for personnel throughout the medical supporting area

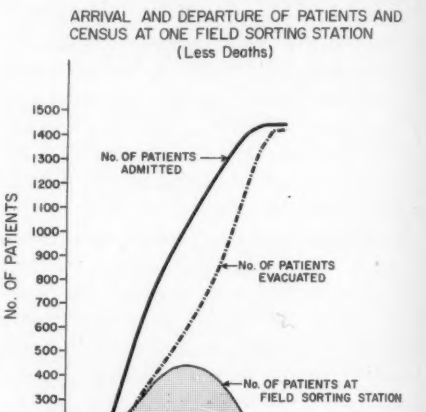

FIG. 1. Demonstration of estimated time and rate of flow.

limits staffing of these stations to teams made up of a minimum number of medical officers, perhaps only one, plus other medical service personnel. In addition to sorting, this station will provide emergency medical care and prepare patients for evacuation. Several sorting stations such as this may evacuate to a single hospital. Each must remain operational until all casualties are removed from the disaster area. Obviously, as the patient flow decreases, medical personnel will be reassigned to areas of greater need.

The previously stated objectives of medical sorting are achieved by classifying patients within categories which indicate the priority for treatment. The type of injuries placed in each category will vary with the tactical and medical situation. In general, however, the principles for selection will re-

main constant for the following categories:

(a.) Minimal treatment—Casualties who do not require hospitalization and can be returned to duty or housekeeping type care immediately following medical aid station treatment.

(b.) Immediate treatment—Casualties for whom the available medical care can be expected to save life or function if performed as soon as possible.

(c.) Delayed treatment—Casualties who, after emergency medical care, incur little increased risk by limited delay in further treatment.

(d.) Expectant treatment—Casualties so critically injured that only complicated and prolonged treatment offers any hope for improving life expectancy.

In order to depict realistically the classification of casualties and provide guidance for planning purposes, the following examples of each category appear reasonable. It is emphasized that these examples apply only to the immediate post impact period, and depending on the medical facilities available and the number of casualties, these examples will differ not only from facility to facility but from time to time at the same station.

1. Minimal treatment—Individuals who can be returned to duty as effectives with relatively minor injuries such as moderate lacerations and contusions, simple fractures of small bones, particularly those involving the upper extremities, and second degree burns of less than 20 percent of the body surface. In addition, there will be convalescent patients and individuals requiring only minimal medical treatment, but who, because of the type of their injuries, cannot take care of themselves. Under usual conditions they would be hospitalized but in the event of mass casualties, their care must be provided in holding detachments or welfare facilities. Examples include second degree burns of the face interfering with sight and eating, incapacitating burns of both hands, and disabling minor fractures.

2. Immediate treatment—Non-effective individuals who will benefit most from early available surgery. Examples include patients with hemorrhage from an easily accessible site, extensive soft tissue lacerations, rapidly correctable mechanical respiratory defects, severe crushing injuries of the extremities for which a guillotine amputation is lifesaving, open fractures of major bones and partial traumatic amputations.

3. Delayed treatment—Non-effective individuals, who although seriously injured, after initial emergency medical care will incur minimal risk from delay in treatment. Examples include lacerations without extensive hemorrhage, closed fractures of major bones, non-critical injuries of the central nervous system and 2nd or 3rd degree burns involving 25-40 percent of the body surface. The latter obviously require active and early resuscitation but following the shock phase, treatment may be delayed.

4. Expectant treatment—These patients will have severe or extensive injuries of the respiratory tract or central nervous system, significant penetrating wounds of the abdomen, multiple severe injuries and 2nd or 3rd degree burns involving 40 percent or more of the total body area.

The proportional distribution among these four categories may vary considerably. The following percentages are suggested for planning purposes:

Minimal treatment	40%
Immediate treatment	20%
Delayed treatment	20%
Expectant treatment	20%

The medical officer selected for sorting teams, aside from being a mature individual who is capable of exercising considerable judgment, also must demonstrate a thorough knowledge of the administrative aspects of disaster medicine. This includes an appreciation of fundamental tactics and over-all logistics. He should have a knowledge of transportation problems and the effect of available transportation on the patients' clinical condition. He requires current information as to the capabilities of the supporting medical units including the surgical "lag" time. Further he must appreciate the duty requirements of partially disabled individuals who

under the prevailing conditions will, of necessity, be returned to duty. Finally, and most important, he must have the courage of his convictions and be able to make rapid decisions for the good of the greatest number of patients rather than for any single patient.

It is apparent that proper and appropriate organization and training of all medical facilities are essential for the successful accomplishment of the medical mission in the event of mass casualties. This is of particular significance when applied to the forward sorting stations. These stations, for all practical purposes, will determine both the direction and productivity of the efforts of the supporting medical facilities during the early post-impact period.

In summary, sorting and classifying of mass casualties is a dynamic medical operation requiring the combined support of all individuals in the area. It will vary with the military situation, the magnitude of the medical problem and the available medical capabilities. The proper application of these functions must embrace the finest traditions of the medical service.

Emergency Medical Care*

By
ROBERT LESLIE SMITH, M.D.†

EMERGENCY medical care has been defined as that treatment concerning itself primarily with *resuscitation* and *essential surgical procedures* that will prevent or arrest deterioration of the patient. Emergency medical care should appropriately take place at any and all levels of the casualty care pattern outlined in a previous presentation. It is acknowledged that emergency medical care may occupy all medical facilities and personnel for so long in the immediate post-attack period that definitive care will be considerably postponed.

The quality of emergency medical care given in the field depends largely on first-aid training for everyone. The life-saving procedures which should be included in such training are:

(1) Application of dressings
(2) Control of hemorrhage
(3) Emergency splinting of fractures
(4) Handling of injured
(5) Artificial respiration and maintenance of airways
(6) Emergency care of certain wounds such as sucking wounds of the chest.

The prime objectives of emergency medical treatment are:

(1) To restore a casualty to a useful state
(2) To increase his self-sustaining status
(3) To preserve life, and
(4) To prevent or arrest physical deterioration until more extensive treatment can be given.

Though emergency treatment is a primary function of aid stations, it may conceivably be required of any medical facility proximate to the source of mass casualties.

In the post-attack period the number of regular medical facilities proximate to the source of mass casualties will certainly be too few to care for the number of casualties anticipated. The Federal Civil Defense Administration has developed a 200-bed Improvised Hospital patterned after the 60-bed Mobile Army Surgical Unit which in Korea provided superior surgical care for nontransportable battle casualties as close as possible to the front lines. The hospital includes some 294 different types of equipment, such as five folding operating tables, a portable field X-ray unit, 200 folding canvas cots, plus sheets, blankets and pillows, surgical knives, forceps, probes, retractors, scissors, sponges, sutures, anaesthesia, antiseptics, antibiotics, bandages, dressings, tourniquets, etc. Enough expendable supplies, such as drugs, medicines, and dressing, are included for the first 36 to 48 hours of operation.

When set up in a building, the hospital includes a sorting room, for classification of casualties, a shock treatment ward, three operating rooms, sterilizing room, central supply room, pharmacy, laboratory, and the usual wards. It also has an x-ray room equipped to turn out 60-second x-rays, with its own portable generator and transformer.

The hospital is the result of a comprehensive study of the problem by medical, nursing, hospital, and supply experts of the Armed Forces, the Federal Civil Defense Administration, and the State civil defense agencies.

The procurement of enough of these hospitals to care for the casualties anticipated has lagged far behind the procurement of other medical reserves by the Federal government, which by the end of Fiscal Year 1956 will be enough to care for 3.5 million casualties.

Procurement difficulties are of great con-

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cern, but of equal concern is the training of the professional and non-professional personnel that will be working in these hospitals. Plans have been developed for placing 26 of these Improvised Hospital units in the seven regions of FCDA where they will be used for exhibition and training purposes.

Resuscitation

Resuscitation will principally involve the treatment of shock following trauma. Whole blood will be one of the most critical items. With a surviving casualty load of 5,000,000 in event of enemy attack, estimated whole blood requirements in the first 72 hours after attack reach a staggering figure of 3,375,000 units. This approximates the Nation's peacetime requirements for whole blood for eight months.

Certain minimum requirements must be met by hospital and community blood banks if they are to be adequately prepared to meet these requirements. Each facility should prepare now to triple its normal capacity by:

(1) Expanding existing safe area facilities.

(2) Selecting and equipping on an improvised basis an alternate site for emergency operations when indicated by the location of the existing facility or by space considerations.

(3) Recruiting and training additional auxiliary personnel for a two- or three-shift, 24 hour operation.

(4) Procuring a reserve of all expendable supplies to sustain operations for 8 to 10 hours.

In addition, plans must be made for other standby emergency facilities, similarly equipped and staffed, so located as to be safe and easily accessible to the available population and to potential donors in undamaged areas immediately following attack. These should provide for the collection of blood in each State at an average of about four times the normal capacity of existing facilities.

The FCDA has procured and is stockpiling expendable supplies and equipment required to collect, process, and ship whole blood. Through Fiscal Year 1955, equipment and supplies for 2,059,000 transfusions has been procured. In Fiscal Year 1956 we anticipate the procurement of 656,204 additional transfusion sets. Procurement of similar sets by the States will bring the present level of stockpiled supplies and equipment for collection and administration of whole blood to over 70% of the number of sets needed for 5 million surviving casualties for three weeks.

Since whole blood cannot be stored beyond two or three weeks, sufficient reserves of blood derivatives and plasma volume expanders must be available until the necessary whole blood can be collected and supplied.

The Federal effort along these lines has resulted in the stockpiling of 1,307,808 units of plasma in 1952 and 1953, and the procurement of a reserve of 225,000 units of serum albumin in fiscal year 1954 and 1955. It is estimated that these blood derivatives are sufficient to care for over 3.5 million surviving casualties.

The need for plasma volume expanders has not been overlooked and proposed Fiscal Year 1956 procurement will bring the Federal reserve of this important element of shock therapy to about the 3.5 million casualty level. Transfusion requirements for 1000 surviving casualties is estimated to be 1500 units of whole blood, 400 units of blood derivatives, and 1100 units of plasma volume expanders.

We cannot rely entirely on whole blood, blood derivatives, and plasma volume expanders for resuscitation therapy, and with the assistance of the National Research Council, the Military, and others, the requirements for intravenous and oral feeding has been estimated. The Federal Civil Defense Administration is well on the way to satisfying these oral and parenteral feeding requirements for 5,000,000 surviving casualties.

Essential Surgical Procedures

Essential surgical procedures embodied in emergency medical care are:

(1) Ligation of accessible major vessels
(2) Tracheotomy
(3) Simple closure of sucking wounds of the chest
(4) Relief of tension pneumothorax and hemothorax
(5) Completion of partial amputations
(6) Removal of large foreign bodies from non-vital areas
(7) Splinting major fractures
(8) Wound dressing.

In the make-up of first-aid stations (about 7500 of which have been purchased by the States) and the Federal reserve of back-up first-aid supplies, in the development of the Improvised Hospital and its back-up supplies, cognizance has been taken of the emergency surgical needs of the wounded. Every effort has been made to incorporate in these supplies and equipment the tools needed for emergency medical care.

A commendable start has been made by the Federal government in establishing a reserve of medical supplies and equipment to meet the needs of mass casualties following enemy attack. Local organization and training of medical and ancillary personnel is necessary for the efficient use of this reserve.

SUMMARY

Emergency medical care will be needed at all levels of the casulty care pattern. The prime objectives of emergency medical care have been enumerated. The FCDA improvised hospital was described. The requirements to be met by community and hospital blood banks have been outlined. A brief summary of the Federal effort along the lines of establishing federal reserves of supplies and equipment to support resuscitation and essential surgical procedures has been presented.

Treatment of Mass Mechanical Injuries*

By

COLONEL JOSEPH R. SHAEFFER, MC, USA†

TO ADEQUATELY comprehend the surgical problems involved in the management of mass mechanical injuries resulting from nuclear warfare it is essential that several established concepts be accepted.

(1) The destructive potential of this device exceeds all previous human experience.

(2) If used, several target areas will be struck simultaneously for maximum effect.

(3) Human casualties, living and dead, will be calculated in the thousands.

(4) Medical personnel, facilities and supplies will be equally decimated.

(5) Lines of communication, transportation and electrical power will be disrupted for an indeterminate number of hours and days.

(6) Radioactivity will be an uncertain antagonist.

(7) In spite of all planning the time and place of arrival of additional medical support will be an uncertainty.

(8) The retaliatory efforts of the military forces will take priority over all other activity.

(9) The local medical objective will be to do the greatest good for the greatest number of injured by promptly carrying out life saving procedures, reestablishing order and organization of treatment facilities.

Under these imposed conditions all physicians regardless of specialty will become surgeons. As such, their initial responsibility will be that of directing care by non-professional survivors and establishing priority for treatment and evacuation for emergency surgery. To be proficient in this responsibility it is axiomatic that they be familiar with the current concepts of traumatic surgery under field conditions which include procedures for initial care, priorities for evacuation, resuscitation and specific surgical technics for all varieties of injuries. Rescue activities will be the responsibility of non-professional personnel. Establishing priorities for care is exceedingly important for in doing so the workload is promptly reduced and those in need of life saving measures and emergency surgery are separated from those who must care for themselves and others. Unless this be accomplished treatment facilities will soon become filled with minor casualties.

In establishing priorities for surgery, casualties fall into three simple groups:

(1) those with minor injuries,

(2) those in need of life saving procedures or initial emergency surgery without which they may not reasonably be expected to survive or without which complications from delayed surgery may unduly prolong convalescence and rehabilitation and

(3) those who are hopelessly injured.

In Group (1) many wounds must be included which normally would benefit from appropriate surgery. It must be recognized that the limited means will of necessity require their deferment.

The number of casualties placed in Group (3) will vary considerably with the time and place. Some patients will be considered hopeless by normal standards, others will become so with the unavoidable delay and lack of adequate resuscitative means or arriving at a treatment facility cannot be prepared to withstand anesthesia or surgery. As conditions improve this group will grow smaller or they will have died. Though none living will be considered abandoned neither can all be saved.

From a surgical point of view, those in

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Group (2) are the important cases to be considered in greater detail. This large group is in need of professional care in treatment facilities. Many of this group will arrive untreated, others with emergency dressings, splints, tourniquets and all sorts of bandages. It is evident that screening on admission is highly important for here again priorities must be established.

Rapid inspection and triage will select those whose dressings for hemorrhage, fractures, head, chest and abdominal wounds need temporary reinforcement. It also will eliminate those whose surgery must be deferred because of the current backlog. Many will be in need of blood and fluid electrolytes before surgery can be undertaken. It is conceivable, however, that much of the emergency surgery will be done without these agents, X-ray evaluation, laboratory guides or anesthesia.

Under conditions of mass casualties the surgeon must be prepared to innovate, improvise and substitute for he is confronted with limited assistance and supplies. He must be prepared to accept compromises and assume calculated risks and penalties, yet he must be decisive and confident for during this period he will be struggling against time and unfavorable conditions. It will be most important that he accepts his assigned position on the team of which he may not be the quarterback.

Fortunately or unfortunately due to lack of experience the principles of surgical management of mass casualties under condition of nuclear warfare have yet to be established. The experiences of mass disaster due to natural causes and military experience where in casualty rates commonly are high have made possible the evolution of certain doctrines from which progress has been made. These doctrines are essentially applicable to military and civilian medicine alike and will be the basis for the opinions which follow. Admittedly some of these opinions remain controversial.

Military surgery specializes in the field of trauma particularly as applied to large numbers of casualties under adverse conditions. The Military Surgeon becomes expert in resuscitation, emergency care, triage and evacuation. The surgical principles employed are essentially those of civilian practice with such modifications as are necessary to conform with the tactical situation. Military surgery is teamwork at its best with emergency care, initial surgery and definitive surgery commonly being performed by different surgeons at a different time and place.

If we are to predetermine what can be done for the tremendous number of injured requiring surgery under these conditions, it is mandatory that several features of the problem be thoroughly understood.

(1) The facilities used will be limited and by usual standards inadequate.

(2) There will be few trained personnel to direct the activities.

(3) Essential supplies and equipment will be quantitatively and qualitatively deficient.

(4) Skilled surgeons will direct those less experienced who will do most of the surgery. These will include doctors other than surgeons, dentists, veterinarian and nurses with operating room training.

(5) Anesthesia will be lacking or inadequate.

(6) Contamination will be universal. Approximately 65% of the casualties will have experienced burns and not less than 25% will have combined mechanical and thermal injuries.

(7) Post-operative care for most cases will be elsewhere for bed space will be limited and soon saturated. Evacuation of surgical facilities must be continuous or they will become paralyzed.

(8) Post-operative care will be the responsibility of untrained personnel for professional supervision could be sporadic for days. These individuals must not be expected to understand and properly manage professional gadgets.

(9) Teams must be set up promptly for human endurance and therefore efficiency is limited. The surgeon's time must not be wasted giving intravenous fluids, applying

bandages, plaster or splints. Furthermore, many patients will have multiple injuries.

(10) Blood, blood substitutes, fluid electrolytes, drugs, antibiotics and antitoxins will be a question of supply.

With these basic facts as a background it seems logical that one must foresee that rapid, simple procedures will be the rule and prolonged complicated technics must be avoided. Sound judgment will be paramount and careless surgery rewarded with just penalty. The golden rule of "What is best for the patient" will apply greater than ever before.

Military experience accepts all such wounds are contaminated. Their treatment is that of cleansing with soap and water, debridement of all foreign material and devitalized tissue, hemostasis, relaxing incisions, counter drainage as indicated, and dressing without closure. By "dressing" is meant keeping the walls of the wound and recess gapping by fluff gauze, an outer firmly applied bandage to control oozing, and immobilization by splint if indicated. Use of wound antiseptics and packing are prohibitive. Wounds properly debrided will cleanse themselves and may be closed in 4-7 days as a rule. If they do not appear clean at this time it usually means debridement has been inadequate.

Considering the vast numbers of soft tissue wounds which may be expected in nuclear warfare it may be necessary to further modify these principles. Because of the workload and limited means in many instances only relaxing incisions of skin and fascia, removal of gross contamination by irrigation, hemostasis, counter drainage and dressing will be feasible. Adequate debridement requires experience and skill neither of which may be available. If this compromise is necessary further surgery may be indicated as determined at time of subsequent dressing. This is a calculated risk which should not cost life but will delay healing and recovery.

The tourniquet is reserved initially for those patients with amputation or hemorrhage uncontrollable by ligation or pressure dressing. An inadequately applied tourniquet increases loss of blood rather than arrests hemorrhage. A tourniquet if not removed within 4-6 hours may necessitate amputation of the extremity. Arriving at a medical facility all such cases are in high priority for care. Removal of the tourniquet and wound examination may permit simple vessel ligation or reveal, unfortunately, no genuine cause for its application. It may be anticipated that many tourniquets will be applied by inexperienced personnel. In any event, arterial repair or graft procedures though highly desirable should not be undertaken under these conditions for they require skill and time both of which are critical items. Removal of a tourniquet from a badly mangled gangrenous extremity could produce sudden fatality or delayed renal death; amputation should be above the tourniquet.

All fractures should be immobilized at the place of injury before evacuation. Conventional splints will not be available and improvising with available material will be necessary. The methods and use of simple substitutions should be widely taught. Arriving at the hospital better immobilization following improved alignment may be required. If plaster casts are used they must be split in their entirety to the skin. No undivided plaster cast should be passed on to a convalescent facility. Complicated definitive procedures should be avoided. Traction devices are impractical, open fractures should be treated as other wounds and immobilized. One should not be tempted to use internal metallic fixation for adequate debridement of such wounds is highly improbable. Joint capsules should be closed leaving the remaining wound open. When time and place permit corrective surgery may be required another day otherwise deformity must be accepted as a penalty.

There will be many extremities with extensive injuries to bones and soft tissues some of which will have seriously compromised vascular and nerve supply. These will require circular amputation at the lowest

level and simple skin traction with casting. One may not depend on frequent observation by qualified personnel for deferred decision. All major surgery must be as definitive as possible and be consistent with sound judgment and available consultation. It must always be recalled that most "after care" will be in the hands of unskilled personnel. Their responsibilities must also be considered.

Normally avulsion wounds of the scalp, face, hands and soles of the feet may be basted to the tissue beneath to prevent skin retraction and delayed wound healing. If so treated, or those of the face primarily closed, they do well. However, the adequacy of the debridement and viability of the wound flaps are always questionable. Repeated observation may not be possible. If this be apparent such wounds are better left unsutured for the penalties of infection from closure are severe. Disfigurement and deformity are problems of another day.

The hand wounds in particular are in need of careful evaluation. All viable tissue should be saved and amputation of a digit determined to be the unequivocal need. Removal of the thumb creates an almost useless hand. Nevertheless any partially functioning hand is better than any prosthetic substitute. Immobilization of the injured hand in the position of function must be stressed in all teaching programs.

The injured eye should be treated by lid closure as a rule; vision in many may be partially restored. Bilateral vision loss will leave a bitter life to face in an uncertain world.

Major wounds of the neck including the mandible are better treated by debridement and dressing with immobilization as required. Occlusive wiring should be avoided if possible for feeding may be a problem in after care. The penalties of inadequate surgical care must be accepted. No patient in mass casualty care should be transposed into a state of being less able to care for himself unless it is mandatory to do so. It must be remembered however that many injuries to this region require early tracheotomy which should be done at time of first emergency surgery. A later hurried call may go unanswered or be too late.

The gaping chest wound must be closed regardless of contamination and the resultant empyema treated as such. Hemothorax should be initially managed by repeated aspiration. Continuous intrathoracic bleeding can only be corrected by thoracotomy which will be predicated on appropriate anesthesia. Pressure pneumothorax is best managed by an anterior intercostal tube and improvised flutter valve. Closed drainage for intrathoracic injury will not be permissible for lack of required care. All such procedures create a nursing problem and problem during evacuation.

Mechanical wounds of nuclear warfare are those produced by flying missles of low velocity. They are therefore penetrating rather than perforating wounds. Such wounds of the abdomen pose a real problem for ordinarily they are considered to be high in priority for surgical treatment. It must be remembered, however, that even under ideal conditions abdominal injuries do poorly and even small wounds of entry, when explored, reveal extensive injury to the viscera within, the repair of which requires familiarity with specific technics and skills. Multiple visceral injuries are common and with delay extensive peritoneal soilage is established. Peritonitis is a frequent sequel even under satisfactory conditions. Continuous postoperative nursing care, intravenous fluids, chemotherapy, efficient naso-gastric aspiration are but some of the personal attentions required if these patients survive. Abdominal surgery is time consuming and whereas the technical management of many injuries may be imparted to those less skilled this is least so in abdominal surgery.

However, certain basic principles apply and should be adhered to.

(1) All wounds of the stomach and small bowel must be closed.

(2) All wounds of the large bowel must be exteriorized.

(3) Wounds of the lower bowel and rectum must be closed, drained posteriorly and protected by a proximal diverting colostomy.

(4) The injured spleen must be removed —never repaired.

(5) The injured liver and pancreas will be repaired and always adequately drained.

(6) The kidney withstands injury well comparatively and may survive with conservative management.

(7) The injured bladder should be treated as a suprapubic cystostomy or closed and protected by an indwelling urethral catheter.

Fractures of the neck and spine are properly treated by casting. Under conditions of mass casualties however initially they remain in low priority, because of more urgent needs. During this period careless handling could result in permanent paralysis, a fate almost equal to death.

In summary, it would appear that when masses of casualties occur the greatest good can be accomplished by devoting maximum attention to the preponderant number of wounds of the soft tissues and fractures. Head wounds, thoracic wounds and abdominal wounds require appropriate facilities and skills and are usually complicated surgical problems and time consuming. Comparatively, these latter under conventional circumstances have a lower survival ratio, require continuous supportive measures, and detailed pre- and post-operative management. Many will die awaiting resuscitation and surgery. The penalties of delayed surgery will add to this toll. It must be evident that the disparity between the available means and number of injured will be extreme for many hours, that most rescue and life saving procedures will be the responsibility of unskilled personnel within the area and that most emergency surgery could be performed by unskilled physicians and paramedical personnel. Likewise, post-operative care will be under the immediate supervision of non-professional personnel.

Under these circumstances compromises must be made and only simple technics employed. Questions of deformity, disfigurement and penalty of loss of limb must not becloud decisive judgment and action. It must be considered in all planning and subsequent undertaking that the great percentage of routine medical care will be undertaken by civilian personnel with and without professional supervision. Any plan otherwise conceived is doomed to failure. Adjustment may be made upward but rarely downward. The sun may shine in some areas but all prediction points to a heavy overcast and torrential rains of frustration. There can be little doubt, however, that a great deal can be accomplished and many lives saved and restored to economic effectiveness if the problems are realistically approached by a citizenry and profession properly schooled in the principles of emergency care of trauma and the necessary compromises which must be accepted when they are faced with masses of casualties. In this training our profession is under moral obligation to assume leadership.

Mass Thermal Burns*

By
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THROUGH the years, mass thermal burns have occurred periodically as in the Coconut Grove, Texas City, Hartford circus, and USS *Bennington* disasters. These, at the time, were considered major disasters but were really trivial in comparison with the vast number of burns that may in the future result from atomic explosions. Even if atomic energy is never used in future warfare, it will soon be used extensively in industry and accidental explosions may occur.

The 20 kiloton fission atomic bombs dropped on Nagasaki and Hiroshima produced approximately 50,000 burns in each city. Burns were the chief injury in 65% of the total number of casulties and approximately 85 to 90% of the patients seeking treatment during the first week had some cutaneous burns. Second degree burns were sustained as far as 4,000 yards from the hypocenter of these 20 kiloton bombs. Subsequent experimental evidence with air bursts indicates that when the size of the bomb is increased, the distance in which burns will be inflicted is also considerably augmented. In contrast, blast and radiation effects increase only slightly as shown in figure 1. Thus, with larger bombs, burns become an even greater problem and will occur in proportionately greater numbers than traumatic injuries.

About 95% of atomic burns are due to radiant energy liberated by the explosion in the form of infra-red, visible, and ultraviolet rays. The remaining 5% are due to ordinary flash and flame burns mostly from secondary fires and burning clothing. The clinical result, however, is essentially the same.

Unfortunately, atomic burns cannot be prevented by evasive action. Pearce and Kinsley[1] have shown with experimental animals that the radiant energy burns from the fission bomb occur chiefly within the first 0.2 second, and that no burn at all is inflicted after the initial 0.5 second. Thus, there is insufficient time to jump behind shielding structures. Clothing especially if heavy and light in color will tend to either reduce or prevent burns. Complete protection, however, is possible only if one is fortunate enough to be shielded from the explosion by either being in a trench or behind a structure that withstands the blast.

With the hydrogen or fusion type bomb, radiant energy that will produce burns is emitted for a longer period of time up to approximately 15 seconds, so evasive action such as jumping behind a wall would be helpful. However, the thousandfold increase in power and relative increase in radiant energy considerably enhance the burn hazard with the fusion bomb.

If an atomic explosion inflicted burns on 50,000 people in one of our moderately large cities and all of the physicians survived the explosion, each physician would have 100 to 500 burn patients to care for in addition to his quota of traumatic injuries. This, of course, is impossible. Each city and each military unit must therefore be trained and organized so that each physician will have an efficient team of nurses, hospitalmen, and first aid assistants, and evacuation of casualties to other more fortunate localities must be given the first priority.

Efficient treatment of mass burn casualties requires standardization of the treatment insofar as possible. Although the ideal treatment must be somewhat compromised in handling massive numbers of burn patients,

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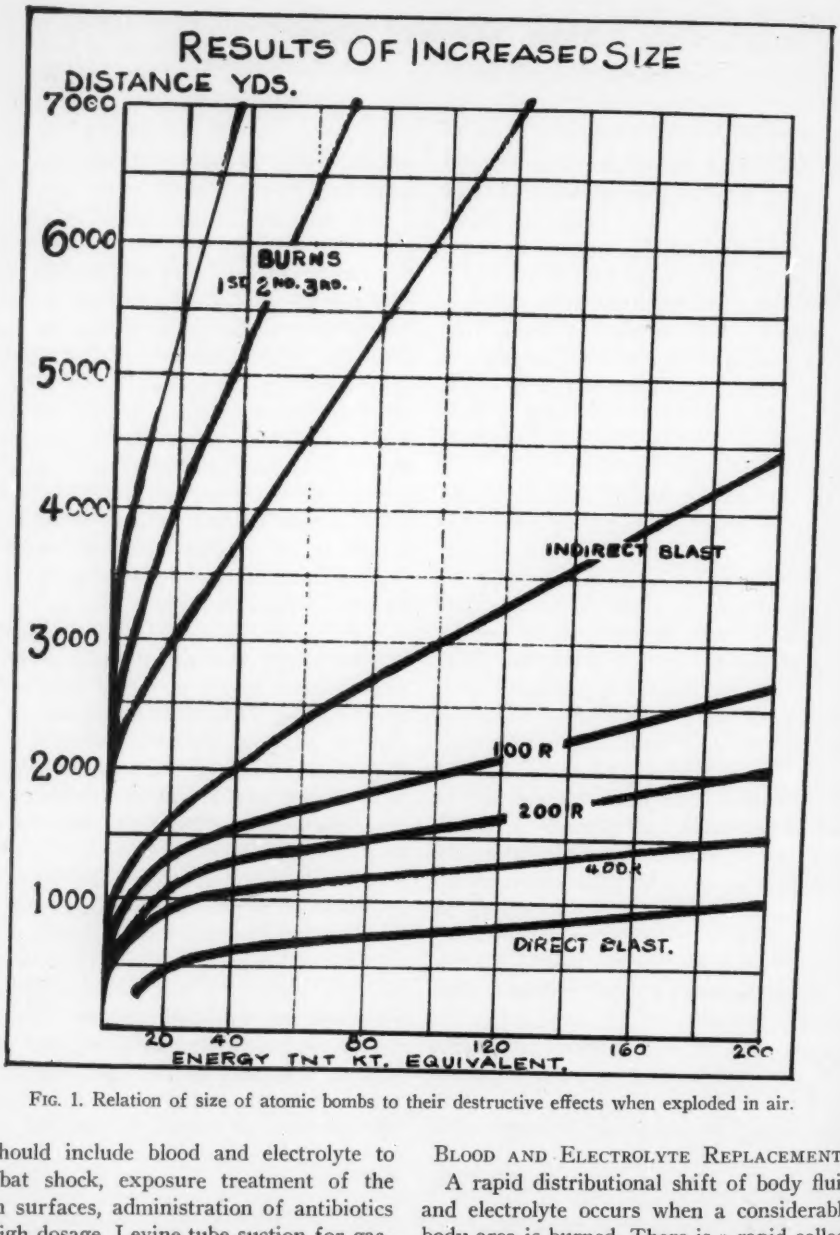

FIG. 1. Relation of size of atomic bombs to their destructive effects when exploded in air.

it should include blood and electrolyte to combat shock, exposure treatment of the burn surfaces, administration of antibiotics in high dosage, Levine tube suction for gastric dilatation, tracheotomy for laryngeal burns, early skin grafting, and maintenance on a high caloric, high protein, high vitamin diet.

BLOOD AND ELECTROLYTE REPLACEMENT

A rapid distributional shift of body fluid and electrolyte occurs when a considerable body area is burned. There is a rapid collection of fluid in the tissue beneath the burn, which becomes evident as clinical edema, and, in addition, there is considerable loss of exudate from the burn surface. In the untreated

burn this fluid is obtained from the extracellular space elsewhere in the body and from the circulating blood. The loss of fluid from the blood causes hemoconcentration with rising hematocrits and a reduction in total circulating blood volume. Clinical shock results and blood and plasma expander solutions are needed to restore the blood volume to normal.

The osmotic concentration of electrolyte is essentially the same in the burn edema and exudate as in normal extracellular fluid and blood.[2] Thus, if solutions of glucose in water are given, there is dilution of electrolyte and water intoxication occurs. Isotonic electrolytic solutions are therefore needed and in an amount exactly equal to the amount of fluid lost in the burn edema and as exudate from the burn surface. Isotonic sodium chloride solution either with or without glucose is effective for this purpose.

Patients with first and second degree body burns of less than 20% of their body surface will usually need no intravenous therapy and can be managed by oral administration of a half normal saline solution contaning 3 grams of sodium chloride and 1.5 grams of sodium bicarbonate per liter. Patients with more extensive burns will require intravenous therapy.

Many formulas have been proposed for the intravenous replacement therapy. Probably the best response is obtained by administering during the first 24 hour period a total amout of fluid (cc) equal to the body weight in pounds times the percentage of body burn, using 50% as the maximum figure for this calculation.[3] One third of the total amount should be blood and plasma expander in equal amounts, and the remainder isotonic saline.

For example: If weight is 150 pounds and burn is 40%

Total fluid = 150 × 40 or 6,000 cc.

Blood and plasma expander = ⅓ × 6,000 or 2,000 cc. 1,000 blood and 1,000 dextran

Isotonic saline = remainder of 6,000 or 4,000 cc.

If in the example the total burn was 80%, the maximum figure of 50% would be used making the total fluid 150 times 50 or 7,500 cc. This formula is designed for the treatment of 2nd degree burns. 3rd degree burns require a slightly larger fraction of blood and plasma expander while 1st degree burns may need no intravenous therapy. Dextran is effective as the plasma expander, but plasma would be preferred when it is free of the homologous serum jaundice hazard.

During the second 24 hour period the same fluids are administered but in half the amounts of the preceding day. In additon, one liter of 5% glucose in water is given. Thereafter, all saline is discontinued and only glucose in water solutions are given in amounts sufficient to maintain hydration. After the second day potassium is administered in large doses to replace the large amounts lost in the urine. Additional blood is needed periodically to correct the anemia which tends to develop from increased red cell destruction.[4]

Patients with burns of more than 25% of their body surface are best managed by placing them on bladder drainage with indwelling Foley catheters. The intravenous therapy is then administered fast enough to maintain the urinary output at approximately 50 cc. per hour. A glance at the urine bottle accurately reflects the patient's response to treatment.

In applying the electrolytic replacement formula, the body surface areas are calculated by the rule of "9." According to this rule, the surface area of the head and neck is 9% of the total body surface, each arm 9%, each leg 18%, the front of the trunk 18% and the back 18%. This is a simple formula easily remembered and reasonably accurate.

After the initial 48 hour period in which the distributional shift of fluid and electrolyte occurs, saline solutions are poorly tolerated for approximately three weeks, and in severe burns even longer. Blood and urinary 17-hydroxycorticosteroid determinations reveal that there is a very high adrenal

cortical response to the burn trauma which persists for several days to several weeks in severe burns.[5] This accounts for the conservation of body sodium. It also indicates that ACTH and cortisone are rarely needed in the treatment of burns and, in fact, may even be harmful.

In patients with extensive burns the common sites for intravenous injections are usually burned so cutdowns for the insertion of polyethylene or polyvinal tubing into superficial veins are generally necessary. These remain patent longer if small amounts of heparin (5 to 10 mgm.) are used in each intravenous bottle.

Exposure Method of Treatment

The treatment of the burn surface is of secondary importance and should be deferred until the patient's condition becomes stable after adequate blood and electrolyte replacement. Cleansing of the burn surfaces by gentle sponging with phisohex and irrigation with saline is then instituted. Loose edges of burned skin are debrided, but blisters are initially left intact. As the debridement is not extensive an anesthetic is not necessary, and analgesia with morphine, meperidine (Demerol), or alphaprodine (Nisentil) is sufficient. Nisentil in doses of 60 to 80 mgm. I.M. or 40 to 60 mgm. I.V. is the most effective of these three drugs, giving analgesia with minimal respiratory depression.[6]

Thereafter, the exposure treatment of the burn surface is advised as it has several advantages over the compression bandage method. The time and work spent in handling the burns is reduced. The cost and need for large stores of sterile bandages is eliminated. The temperature regulatory system is aided in the elimination of excess body heat that may be retained under bulky dressings. Maceration and secondary infection of normal surrounding skin is prevented. The tourniquet effect on respiration and limb circulation is eliminated. Patients are more comfortable after the first 48 hours. Odor is markedly reduced. The patient's morale is improved as localized burns are not exaggerated by large circumferential dressings. Finally and most important of all, it reduces infection and thereby the amount of grafting. The coagulum which forms seems to be impervious to infection, but when infection does occur it is easily located and can be promptly drained before the islands of regenerating epithelium are destroyed making grafting necessary.

Unfortunately, the exposure treatment also has some disadvantages. A hospital environment is desirable during the first 72 hours. Patients must be in a warm building until the coagulum forms. Evacuation of severe burns during the first 72 hours is not advisable. Finally, patients with circumferential burns must be turned frequently. The latter, however, does not apply to most atomic burns as only the side of the body exposed to the explosion is burned unless secondary flame burns are also sustained.

By exposure to open air a coagulum forms over the burned surfaces in 48 to 72 hours. This protects the burns and thereafter the patients are reasonably comfortable. When the burns are circumferential, patients must be turned at 4 to 6 hour intervals preferably on Stryker frames in order for the coagulum to form. The turning must also be continued thereafter or the coagulum will break down. The burn surfaces must be inspected daily and wherever there is evidence of infection the area is debrided. Blisters are removed on the first sign of infection or whenever there is a marked temperature elevation. After infection is drained a new coagulum will again form and the exposure treatment can be continued.

Superficial split thickness burns heal in 10 to 14 days leaving a pink new skin as the coagulum peels. Deeper split thickness burns, in which only islands of epithelium remain about hair follicles and sebaceous glands, heal in 3 to 4 weeks and the coagulum becomes nodular and quite thick before it spontaneously peels. Eschars form over third degree burns quite rapidly and remain intact for approximately two weeks before separation begins. Once these areas beome moist, daily dressings must be instituted.

FIG. 2. Clean, dry, protective coagulum as it appeared on the sixth day on a patient with circumferential burns of thorax, arms, and legs.

A typical clean, dry coagulum that formed on the back of a patient with burns of the head, thorax, and extremities is shown in figure 2 as it appeared on the 6th day. The entire back healed spontaneously without any evidence of infection. The area just below the shoulder bordered on third degree but eventually healed without grafting. Most of the right arm required grafting. At this time the patient's extra-cellular space was expanded by 3 liters as determined by the radioactive sulphur$_{35}$ method. On the 15th day he had a total blood volume deficit of 1,700 cc. as determined by the chromium$_{51}$ tagged red blood cell technique. At the same time his hematocrit was 52%. Total blood volume studies were repeated as additional blood was administered and confirmed the deficit indicating that the determinations were accurate. Thus, the value of total blood volume determinations is emphasized.

Protective clothing will often prevent both flash burns and radiant energy atomic burns. The patient shown in figure 3 was wearing underwear shorts when exposed to a flash burn and this protected most of his buttocks. His legs, which were exposed, sustained deep burns extending through the pigment layer, making it impossible to tell from the burn surfaces whether he was Caucasian or Negro. Nevertheless, healing was spontaneous without infection except for an area on the lateral side of his right ankle which required grafting.

ANTIBIOTICS, TUBE SUCTION AND TRACHEOTOMY

Antibiotics are administered to burn patients in high dosage. Penicillin and streptomycin are probably preferred initially and after the first 5 to 7 days are changed as indicated by cutaneous cultures and blood cultures or as sepsis appears. Chloramphenicol (Chloromycetin) appears to be the next most effective drug. Tetracycline and all the other antibiotics are helpful and are used as indicated by cultural sensitivity.

Patients with burns of 30 to 50% of their body surface frequently develop gastric dilatation, requiring Levine tube suction and in the severely burned this is so common along with paralytic ileus that routine tube suction is desirable in all patients with burns of more than 50% of their body surface for the first forty-eight hours.

FIG. 3. The protection afforded by underwear trunks is shown on this patient who sustained second degree burns of the exposed legs.

Whenever a patient's face is burned there is apt to be an associated burn of the larynx and respiratory passageways. Vigilance must be maintained for early respiratory distress and tracheotomy instituted at the first sign of difficulty. A mixture of Alevaire and isopropylarterenol (Isuprel) in a nebulizer is often effective for minor degrees of respiratory trouble.

Skin Grafting

Excisional skin grafting during the first few days after the burn has been recently advocated. By this technique the eschar and subcutaneous tissue are excised down to a viable base and split thickness skin immediately applied. As it is difficult to accurately delineate the third degree areas prior to the 10th to 14th days, considerable viable epithelium is generally removed by this method. In addition, early extensive grafting in the badly burned patient may jeopardize his survival. Coagulation of superficial blood vessels in the eschar, loss of pain sensation to pin prick, and an early, dry, leathery type eschar are the usual signs indicating third degree burns, but these are not entirely reliable. However, fine nodularity of the coagulum occurring during the 6th to 12th days over a burn treated by the exposure method is a reliable sign that the area is healing from islands about hair follicles and sweat glands. Occasionally an eschar will so constrict a finger or an extremity as to impair the blood supply and excisional grafting is then imperative.

Lay on grafting using either sheets or postage stamps of split thickness skin after preparation of the recipient surface gives just as good or even superior functional results. The recipient surface is best prepared by surgical debridement of the area about the 14th day followed by daily saline dressings until the surface presents a red granular base. Proteolytic enzyme 7-1162-D-11 (Lederle), and Proteinase A (Sharpe & Dohme) tend to speed up the debridement somewhat but are expensive and generally not too effective.

Maintenance of nutrition with a high caloric, high protein, and high vitamin diet is important during the grafting phase. Transfusions are also necessary to maintain the total circulating blood volume. Unless the serum proteins and total blood volume are normal, and infection is controlled, the percentage of take in skin grafting is disappointing.

Using this form of treatment, excellent results were obtained with the USS *BENNINGTON* casualties at the U. S. Naval Hospital, Newport, Rhode Island.[7] As shown in figure 4, 93% survived 25 to 50% second and third degree burns, and 79% survived 50 to 75% second and third degree burns.

Fig. 4. Results of treatment of the USS *Bennington* burn casualties.

% Body Burn	Total	Survived	% Survived	Deaths
0– 25%	39	38	97%	1
25– 50%	14	13	93%	1
50– 75%	14	11	79%	3
75–100%	7	0	0%	7

Application to an Atomic Disaster

Such results cannot be expected in an atomic disaster, but with efficient organization and planning many lives may be saved that might otherwise be sacrificed. Every effort must be directed towards the prompt evacuation of as many casualties as possible. Nonprofessional personnel must be trained to assist professional teams in a standardized method of burn treatment. Patients with burns of less than 20% of their body surface can and must care for themselves to a large degree by drinking half normal saline and perhaps by even cleansing their own burns. They can remain ambulatory and can be promptly evacuated.

Physicians should concentrate their attention on patients with burns of 20 to 40% where the greatest number can be saved with reasonable care. Probably few patients with

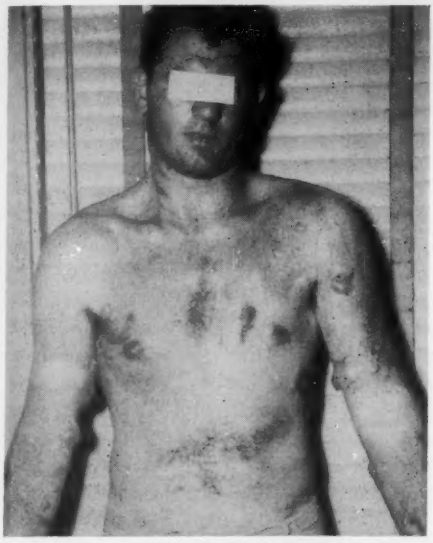

FIG. 5. This patient photographed on the second day required relatively little treatment for his superficial burns even though fairly extensive.

2nd and 3rd degree burns of more than 50% of their body surface can be saved under such circumstances, especially since some of these may have received sufficient ionizing radiation as to depress their bone marrow and thereby reduce their resistance to infection. Thus, it is useless to spend valuable time treating such severely burned patients when many with lesser burns can be saved.

Many atomic burn patients will be similar to the patient shown in figure 5. This patient sustained first and second degree burns of 36% of his body surface from steam. Although he required intravenous support during the first eight hours, he thereafter sustained himself on half normal saline orally. On the second day when the photograph was taken, he was ambulatory, comfortable and relatively happy. As his burns were quite superficial he required very little therapy. Although some of the burns from an atomic explosion will be deep and extensive, many will be similarly superficial. Relatively meager support for such cases will be rewarded by the survival of many that otherwise might die.

SUMMARY

1. Burns account for the greatest number of casualties from atomic explosions. Previous planning and organization are essential in coping with such disasters and the plans must emphasize the evacuation of as many as possible to surrounding medical facilities.

2. Adequate blood and electrolyte replacement is the first consideration in the management and is effectively accomplished by the formula outlined.

3. The exposure treatment of the burn surfaces will usually be the most practical method of managing mass burn casualties.

4. With overwhelming mass burn casualties more lives will be saved by concentrating on those with moderate burns rather than attempting extensive treatment of those with severe burns.

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PRINCIPLES OF CARE OF MASS CASUALTIES*

Introduction to the Problem

By

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IN DEVELOPING the theme of the principles of the care of mass casualties, we will this afternoon continue the consideration of the treatment of certain specific types of injuries and some general considerations that underlie the treatment of all types of injury.

This morning, discussion took place concerning protective measures, casualty estimates, initial aid and rescue, sorting and classification of casualties, emergency medical care, the treatment of mass mechanical and thermal injuries. This afternoon we will consider the treatment of radiation injuries, psychiatric casualties, the use of antibiotics, blood and plasma volume expanders, anesthetic agents and the costs of delays in treatment.

The treatment of radiation injuries has assumed more than usual interest because of the development of thermonuclear bombs which produce radiation effects not only at the site of the explosion, but also at considerable distances because of the fallout of radioactive particles. In our discussion this afternoon we will be concerned with those who receive an initial large dose of radiation at the site of the detonation of the bomb as well as those whose exposure has been accumulative due to residual contamination, or from fallout of radioactive particles. The principles of treatment in both groups are the same. We will be less concerned with the treatment of the late effects of radiation on those who survive.

In treating mass radiation casualties, we must be guided by the same general principle that is applied in treating mass traumatic and thermal injuries—that of treating only those who have a chance of survival and who require treatment in order to live. We cannot afford to expend life-saving drugs, antibiotics, blood and blood substitutes as well as the time of essential personnel on those who have little chance of recovery because of the lethality of their injuries, or on those who would recover without treatment. This then is the important problem in the treatment of mass radiation casualties—that of sorting the patients into groups—those who have received a lethal exposure and who will die in spite of the most heroic treatment, those who have received a median lethal or moderate dose who must be treated to survive and those with minimal exposure who will recover with minimal treatment.

In the discussion of the treatment of radiation injuries, we are also interested in a consideration of the shielding effects of shelters, buildings and trenches in prevention of radiation injuries both in the case of the so-called super weapons and the smaller tactical weapons that we in the military may well be exposed to. And lastly we are interested in the most effective treatment for those cases of radiation injury we have selected for treatment.

PSYCHIATRIC CASUALTIES

Of less immediate consideration as far as life and death is concerned is that of the psychiatric casualties that may occur. However, if only by reason of numbers, consideration must be given for their care in any program for the treatment of mass casualties. From experience gained of the effect of nuclear weapons on the populace at Hiro-

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shima and Nagasaki and from that gained by exposure to massive bombing attacks by conventional weapons in London, Germany and Russia during the war, it must be said that the public in general behaves better from a psychiatric point of view than might generally be believed. However, those who are immediately exposed may well develop evidences of mass panic and transient emotional disruption and fear reactions.

It is important for those of us in military life as well as for civilians in official positions to have a knowledge of the underlying psychological and emotional responses of groups exposed to common danger and how these responses are expressed.

It is equally important to know some of the simple and effective means of treating those immediately affected and some of the measures that can be used to counteract mass disorganization and panic.

In estimating and planning for the number of personnel needed to take care of the victims of a mass atomic attack, we are all overwhelmed by the numbers of trained personnel needed. Such personnel will be available only if detailed planning of all requirements is made. In making such plans and estimates, adherence must be kept to the adage of treating only those who have a chance of survival. In considering the question of survival, consideration must be given to the effects that early treatment has on the number of survivors. Such early treatment as the stoppage of hemorrhage, the correction of blood deficiencies, debridement of the amputation of mangled extremities, the non-operative treatment of penetrating chest wounds and the prompt treatment of penetrating abdominal wounds may significantly lower the long range survival. Doctors Howard and DeBakey have made an interesting study of this problem.

In the supportive treatment of mass casualties we depend upon the use of biological agents for the production of passive and active immunization, the use of antibiotics to prevent and suppress infection and the use of blood and plasma volume expanders to correct hemorrhage, prevent shock and replace needed blood elements. We shall be interested in hearing of their use, the ones recommended for use, and the state of supply of these much needed ancillary agents.

Of no less importance in connection with the treatment of traumatic injuries is that of anesthetic agents, sedatives, and of the need for anesthesiologists.

We have an interesting afternoon in store for us for we have men of outstanding competence in their fields who will discuss these important problems for us.

Treatment of Radiation Injuries*

By

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RADIATION injury is a new addition to problems of military medicine in the future. Perhaps it would be best to review the nature of radiation injury and its diagnosis. This background would enable the physician to logically consider the care of radiation injury, which, in contrast to thermal burns, during its inception has one merit—it is generally painless. Radiation injuries may be divided into superficial injuries produced by less penetrating forms of radiation, i.e. beta, and the various syndromes of whole-body radiation injury that are produced by more penetrating forms of radiation, e.g. high energy gamma radiation and fast neutrons. To the large animal it makes little difference whether the syndromes of whole-body radiation are produced by gamma or fast neutrons. The results are approximately the same and the relative effectiveness of the neutron is not much greater than that of gamma radiation alone.[1] The two appear to be additive. There are two sources of radiation. First, the short burst radiation that is produced at the time of detonation of the weapon and shortly afterwards consisting of gamma radiation and neutrons. Second, the field of residual radiation that is produced by neutron induced radioactivity in the soil and by the distribution of fission products on the ground. The latter is insignificant with conventional high air-burst weapons, but becomes of considerable importance with ground or close to ground, particularly high yield bursts as was accidentally demonstrated in the Pacific in March of 1954.

First, I will consider the syndromes of whole-body radiation injury. The syndrome varies with the dose of radiation. For practical purposes, the syndromes can be divided into three distinct types: first, the *neurological type* produced by many thousands of roentgen units in which death is immediate or occurs within a few hours and is characterized by neuro-muscular symptoms; second, the *gastro-intestinal type* produced by 1-3000 r with death occurring within three to six days and characterized by gastro-intestinal symptoms such as nausea, vomiting and the concomitant dehydration as a result of the loss of fluids and electrolytes; third, the *hemopoietic type* produced by 200-1000 r which may produce death within one to eight weeks. The latter is characterized by the sequelae of pancytopenia; namely, anemia, hemorrhage and infections in the presence of granulocytopenia. It is the latter syndrome with which one is concerned for practical purposes. The doses of radiation which produce the gastro-intestinal syndrome have been shown in animals to be almost uniformily fatal. The experiences of the Japanese at Hiroshima and Nagasaki tend to bear this out. The neurological type of syndrome was not observed by the Japanese, but in animal experimentation has been shown to be uniformly fatal. Amounts of radiation in excess of 3000 r are required, quantities which, in the terms of our present knowledge, are absolutely fatal doses of radiation. Experimentally, it has been shown by Conard *et al.*[2] that the gastro-intestinal syndrome is in itself not necessarily fatal and that in dogs the large-scale replacement

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of fluids and electrolytes may prolong life with histologic recovery of the gastro-intestinal mucosa. However, the animals die at a later time from the sequelae of pancytopenia with an aplastic bone marrow. From a practical standpoint one is therefore confronted with the therapy of the hemopoietic syndrome. Since the syndrome of radiation injury, due to whole-body penetrating radiation, varies with the dose, the symptomatology in a sense, is a dosimeter. However, estimations of the severity of exposure to gamma radiation in the lower dose ranges becomes of considerable practical importance since survival in the lethal range is dose dependent. The problems involved with estimation of dose received by the individual are really difficult. It is possible that dose estimates may be available from dosimetry devices, or from dose contour lines and the position of the individual during exposure. Some of the difficulties of relying heavily on dose estimates are obvious. The exact position of the individual and the degree of shielding will not be known. The dosimetry device records the dose the instrument receives but may not reflect accurately because of shielding, energy dependence of the device, etc., the dose received by the individual. More important, because of individual differences in sensitivity, individuals exposed to the same measured dose may differ widely in their responses. Thus, no estimate of dose derived from dosimeters or from the position of the individual during exposure can be taken as an accurate index of the probable fate of an individual, or as the final index to sorting and therapy. However, doses of gamma radiation greater than 800 r will in all probability be fatal and doses less than 200 r sublethal.

The best approach for estimating the seriousness of exposure of the individual may be termed, the symptomatic approach. As with any disease, an accurate appraisal of the patient's condition results only from a thorough evaluation of the history, physical and laboratory examination. If heavy exposure has occurred, nausea and vomiting will follow in most individuals within a few hours. This does not necessarily indicate a poor prognosis. Heavily exposed individuals may be divided into three groups in which survival is respectively, *improbable, possible* and *probable.* It will be apparent that there is no sharp line of demarcation between the groups.

Group 1—*Survival improbable:* If vomiting occurs promptly or within a few hours and continues and is followed in rapid succession by prostration, diarrhea, anorexia, fever, the prognosis is grave; death will almost definitely occur in 100% of the individuals within the first week, irrespective of what the dose estimate may be. There is no known therapy for these people, accordingly in a catastrophe attention will be devoted to others for whom there is some hope.

Group 2—*Survival possible:* Vomiting may occur early but will be of relatively short duration, followed by a period of well-being. In this period of well-being, marked changes are taking place in the hemopoietic tissues. Lymphocytes are profoundly depressed within hours and remain so for months. The neutrophile count is depressed to low levels, the degree and time of maximum depression depending upon the dose. Signs of infection may be seen when the total neutrophile count has reached virtually zero (7-9 days). The platelet count may reach very low levels after two weeks. External evidence of bleeding may occur within two to four weeks. This group represents the lethal dose range in the classical pharmacologic sense. In the higher exposure groups of this category the latent period lasts from one to three weeks with little clinical evidence of injuries other than slight fatigue. At the termination of the latent period, the patient may develop purpura, epilation, oral and cutaneous lesions, infections of wounds or burns, diarrhea, and melena. The mortality will be significant. With therapy the survival time can be expected to be prolonged and if sufficient time is provided for bone marrow regeneration the survival rate will be increased.

Group 3—*Survival probable:* This group consists of individuals who may or may not

have had fleeting nausea and vomiting on the day of exposure. In this group there is no further evidence of effects of the exposure except the hematologic changes that can be detected by serial studies of the blood with particular reference to lymphocytes and platelets. The lymphocytes reach low levels early, within 48 hours, and may show little evidence of recovery for many months after exposure. The granulocytes may show some depression during the second and third week. However considerable variation is encountered. A late fall in the granulocytes during the sixth or seventh week may occur and should be watched for. Platelet counts reach the lowest on approximately the 30th day at the time when maximum bleeding was observed in the Japanese who were exposed at Hiroshima and Nagasaki. This time trend in the platelet count and the development of hemorrhage is in marked contrast to that seen in laboratory animals when platelets reach their lowest level around the 10th to 15th days and hemorrhage occurs shortly thereafter.

The above classification is synthesized from the Japanese experience and animal data.

The syndromes described above may occur not only as a result of exposure to the initial radiation from the atomic bomb but may also be produced by exposure to radiation from fall out. In the case of the former, radiation is received over a period of only a few seconds and in the latter the dose rate varies with the time after detonation. The dose rate from the field of fission products varies roughly with the minus 1.2 law. For example, the dose rate one hour after the blast will fall 44% of this value within the next hour or two hours after the explosion. However, at ten hours after the blast, the given dose rate will fall by only 11% of its value during the next hour; for example, the dose rate at 11 hours will be 89% of what it was at ten hours. In other words, if the maximum fall out and thus the maximum exposure rate to fall out has not occurred for several hours after the explosion, the rate of fall off in the area obviously will not be as rapid as it would be from earlier fall out material. In the case of very early fall out shelter is essential until evacuation because of the high dose rates. In the case of fall out occurring at a later interval when the dose rate is relatively constant and much lower, evacuation and/or shelter will significantly reduce the total exposure. The initial radiation and fall out radiation also vary in respect to the effective energy. As shown by Cronkite *et al.*[3] the spectrum of the atomic bomb gamma radiation at distances in which survival is possible has a relative biological effectiveness of about 1.0 in mice which are "thin foils," however the highly energetic component of the radiation may so increase the depth dose in larger animals that the effectiveness may increase. The spectrum from the field of fall out radiation has a very wide spectrum of inherent energy that is degraded by Compton scattering so that there are peaks at 100 KEV, 600 to 800 KEV, and 1,600 KEV. Shelters are effective. The following estimates have been released:[4] A frame house would reduce the total dose received by one-half; a brick or concrete structure would be more effective obviously. The basement would reduce the total exposure to about one-tenth of the air value. In a shelter of thickness equivalent to 3 ft. of earth, the dose would be reduced 1/5,000 of its value, affording complete protection in the most heavily contaminated area. Thus the most effective therapy is prophylactic—shelter and evacuation.

The relative radii of effectiveness of ionizing radiation, blast, and thermal effects vary with weapon size. With small weapons the radiation is relatively more effective. However, with the larger weapons the initial radiation does not extend beyond the reach of total destruction by blast and thermal effects. Accordingly, in the latter situation radiation injury from the prompt radiation is relatively unimportant because those who would be in the region where recovery is possible from radiation alone would have a very little chance of surviving from the other effects

of the device. However, it is feasible to get good protection from the blast and thermal effects of small weapons by appropriate use of cover and shelter. In this tactical situation radiation injury uncomplicated by trauma may be seen. With super weapons fall out is probable and has been shown capable of producing radiation injuries.[5] As a result of the accident in 1954 a considerable amount of information was obtained on the nature of both skin and whole-body radiation injury of human beings produced by exposure to fall out radiation. Following the visible snow-like fall out, there was burning and itching of the skin on the day of exposure, lacrimation and burning of the eyes. These symptoms subsided promptly. At the time of appearance of the lesions described in detail elsewhere[5] there was considerable burning and pain connected with movement. Treatment of these lesions was entirely symptomatic except for those which became infected. In these instances parenteral penicillin and aureomycin ointment was used.

A considerable amount was also learned about whole-body radiation of the human being in the sublethal range. Following 175 r whole-body radiation, accumulated over a period of 47 hours, the following sequence of events was observed in the average peripheral blood counts. Leukopenia and thrombopenia was present. Granulocyte counts as low as 500 and platelet counts as low as 35,000 were observed; however, only for a short period of time. Had the dose of radiation been larger the depression would have been more pronounced and of longer duration. For our purposes here, there is no need to go into a detailed study of the dose response of the granulocytes and the platelets nor of the fact that the duration of depression increases as the dose increases. In a general sense there is a period of time during which life is compatible with very low granulocyte and platelet counts. However, if marrow recovery does not occur within a matter of a week or so the probability of overwhelming infections and massive hemorrhage becomes increasingly greater. Anemia will become prominent as blood is lost by hemorrhage and the marrow fails to produce new cells. The therapeutic problem is obviously the treatment of the sequelae of pancytopenia, namely, infections, hemorrhage, and anemia. Since little can be done for the anemia and hemorrhage except replacement of blood as needed to sustain life, the therapy is mainly aimed at control of infection. In most species infection is a predominant cause of death in the lethal range, however obliteration of infection by the germ free state in rats does not eliminate death due to other causes.[6] In these animals death occurs from hemorrhage and a profound anemia.

The increased susceptibility to infection results from multiple causes and has been recently reviewed[1] and may be summarized as follows:

a. Granulocytes are decreased in number.
b. Granulocytic functions are impaired.
c. The reticuloendothelial system phagocytizes bacteria but does not kill the ingested bacteria as readily.
d. Acquired antibody production is diminished.
e. Natural antibody (properdin) titres decrease.
f. The connective tissue of the skin is altered.

There is little wonder that infection occurs with almost all defenses impaired. In fact, infections are generally produced by commensal organisms in addition to pathogens if present in endemic or epidemic states. Experimental work in animals has clearly demonstrated that immunization to specific bacteria increases the survival rate when the animals are later challenged by the same bacteria.[7, 8, 9] In addition, antibiotics have been shown to be of definite value when the offending organism is susceptible to the antibiotic and when the dose of radiation is in the mid-lethal range but not after higher doses.[9, 10, 10a] Accordingly, certain general principles can be stated about therapy:

1. Active immunization in those instances

when feasible will increase the chances of survival against specific infections. This is automatically accomplished in the military establishment and should be urged for the population at large.

2. Diverse oral antibiotics with a wide antibacterial spectrum are needed in the stockpile.

3. Group 3 type casualties will need little or no active therapy *per se*—observation and available treatment of complicating wounds or burns should suffice. It was learned from the Marshallese incident that group 3 (sublethal) radiation casualties could tolerate an epidemic of upper respiratory infections, presumably of viral origin, as well as the unexposed group, with no untoward effects. Of considerable importance logistically, this category can be ambulatory, physically fairly active and should be useful citizens or soldiers while under observation and can and should be at work. For more definitive management of radiation injury it appears desirable to divide the problem into the ideal situation, where there are only one or a few casualties, and the problem of mass management in the case of nuclear warfare. In the former case the situation should be handled as a research problem and in the latter case compromises must be made in order to distribute medical care where it will be most effective. First the ideal situation will be considered for each of the categories described earlier:

Group 1—*Survival improbable:* 1. Bed rest will be mandatory since these individuals will be sick from the time of exposure.

2. Nutrition will be parenteral. Water and electrolyte balance will have to be maintained by large volumes of intravenous saline—glucose, plasma, and balanced electrolytes as necessary. For a matter of many days the bowel will not tolerate anything other than small quantities of fluids.

3. Nursing care must be of the highest order. Particular attention should be paid to the hygiene of the mouth, teeth, skin and the perineal area since these are the locations aside from wounds where infection frequently develops and progresses to an overwhelming sepsis. Aseptic technique is paramount.

4. From the fifth day after exposure one can anticipate the development of spontaneous infection at most any time. Antibiotics should be commenced about the fifth day and one should be prepared to use them in combination with maximum doses as necessary to control infection.

5. From the 7th day on, an anemia, due to hemorrhage and cessation of blood cell production, will develop unless dehydration produces a hemoconcentration. A reasonable plasma volume must be maintained. As anemia develops fresh whole blood collected in plastic bags with di-sodium salt of ethylenediamine tetra-acetate (EDTA) as the anticoagulant should be administered as necessary. If hemorrhage is prominent in presence of a marked thrombopenia, platelet transfusions should be given daily.

6. One should seriously consider the use of homologous intravenous or intramedullary bone marrow, even though permanent restoration of hemopoiesis has only resulted with genetically specific bone marrow.[1]

7. Complete electrolyte and blood chemistry studies should be performed and all excreta saved and properly measured for studies of amino acid and steroid excretion in addition to other substances that may become of importance in the future.

8. Since knowledge of severe radiation injury in human beings is scanty, extensive studies on the metabolic cycle of labelled compounds should be pursued at every opportunity. In parallel all efforts should be made to prolong life as long as possible in order to learn more about the spontaneous course of human radiation injury of all degrees of severity.

Therapy of Group 2—*Survival possible:* 1. The general management of this category is identical to group 1 but will not demand so much attention during the first few days since vomiting and diarrhea will subside within a day or so.

2. Infection is the major hazard. Meticulous daily physical examinations looking for evidence of beginning infection are the key

to therapy and commencement of antibiosis, oral and parenteral. Premature administration is contraindicated because of the hazards of sensitization of the patient and development of bacterial resistance to the antibiotics.

3. Transfusions of whole blood or separated platelets and leukocytes will be indicated by the need. Transfusions should be resorted to only when actually needed since there is no evidence to date that maintenance of red cell and platelet levels will increase the survival rate *per se*. One can qualify need as distressing anemia for whole blood, spontaneous bleeding for platelets and infection uncontrolled by antibiosis for leukocytes.

Therapy of Group 3—None needed. Observations are identical. All radiation injury complicated by wounds and burns, will be more serious. The development of bacterial epidemics will probably lessen the chances of survival from radiation injury. A potential complication in combined radiation and traumatic injury is the unfavorable effect of dextran in producing bleeding in the presence of a lowered platelet count.[11]

What will one do in the event of large scale nuclear warfare if there are thousands of radiation casualties from fall out? Quite obviously one will not be able to afford the luxury of pursuing clinical research as previously recommended for the ideal situation of handling the occasional injury if there are thousands or more of radiation injuries from fall out.

Let us not delude ourselves by wishful thinking. For the *Group 1, Survival improbable,* nothing can or will be done. The entire remaining medical apparatus will be too busy trying to salvage casualties with major traumatic and thermal injuries. Everyone will be practicing surgery whether it be his desire or not.

For *Group 2, Survival probable,* no care will be needed for days or 2-3 weeks. If, during this period, these radiation casualties are concentrated in a central area it should not be an impossible task for a few physicians with assistance of some nurses and technicians to provide reasonable care to many hundreds of casualties. Oral wide spectrum antibiotics must be available and administration can be commenced at the earliest sign of clinical infection. Leukocyte counts would be extremely useful but may not be feasible. At this time, I am reluctant to recommend wholesale prophylactic antibiotic therapy to the group 2 radiation casualty unless bacterial epidemics develop.

Group 3, Survival probable, will need no therapy except for whatever wounds they may have incurred. However, if epidemic bacterial diseases appeared, I believe prophylactic antibiotics would be clearly indicated.

The choice and dose or combination of antibiotics can not be specified logically at this time. This will depend upon their availability and need for continued therapy of traumatic and thermal injuries. However, it does appear that only oral wide spectrum antibiotics will be practical.

In conclusion, radiation injury *per se* from fall out should not be a major problem if troops and civilian populations are properly educated and prepared. It can be largely avoided or minimized by shelter or evacuation. Radiation injury from the initial radiation except in specific tactical situations with small weapons will be relatively unimportant. Trauma and thermal burns will dwarf radiation injury as a practical problem. Under catastrophe conditions one must compromise drastically with the ideal situation; reserve stores of blood and plasma for the traumatic casualties when it is of known value; and endeavor to control infection by oral wide spectrum antibiotics. In closing, progress is obviously being made in practical consideration of mass care of casualties. Compromises in therapy towards expediency have been made. The psychologic adjustments for the profession and for the public are painful but the compromises enable one to do the most good for the maximum number in view of what is known and available today. It would be unfair to state that there is any early probability of developing an antedote for radiation injury. Much has been learned about the spontaneous course and the acceleration of restoration from radia-

tion injury at an experimental level, but there is nothing that is clinically practical for use on human beings on any scale at the present time.

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Management of Mass Psychiatric Casualties*

By

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IN THE event of atomic warfare, military medicine will be confronted with the difficult task of caring for mass casualties which in numbers and rapidity of production far exceed any of its previous experiences in conventional combat. Part of this medical responsibility will consist of relatively uninjured persons with varying degrees of mental incapacity due to the psychological trauma that inevitably accompanies exposure to massive physical destruction. This aspect of the management of mass casualties assumes major military significance in atomic attack for only by the efforts of physically intact survivors can there be prompt lifesaving aid and rescue of the severely injured or effective reorganization for defense against an immediate enemy assault to exploit the tactical situation.

A reasonable forecast of the mental abnormalities to be expected under conditions of nuclear warfare can be inferred from past experiences with similar episodes of catastrophic trauma. Relevant data for this purpose are available from: (a) conventional combat,[1,2] (b) civil disasters,[3,4] (c) aerial bombardment,[5] and (d) atomic bombing of Hiroshima and Nagasaki.[6,7,8] Analysis of the foregoing traumatic situations permit the following general conclusions relative to behavior under severe external danger, irrespective of the causative agent or the culture of the individuals involved.

1. Instances of mass panic are relatively uncommon and mainly occur under circumstances where there is partial entrapment.[9]

Panic is usually defined as uncontrolled flight behavior or frantic purposeless activity. Favorable conditions for mass panic are established when a poorly led or an unorganized aggregation of individuals are faced with presumed or actual imminent destruction in an environment where there is a rapidly narrowing or limited escape route but one believed open to safety. Under these circumstances, there is precipitous flight to and if possible through the escape channel in order to avoid entrapment. But when the escape route is closed or becomes jammed, the momentum of the original drive toward safety continues its forward urging force with blind irrational activity. Such panic behavior quickly becomes widespread. Individuals involved are pushed and trampled upon, and rational thought is lost as other possible means of escape are not explored or utilized if available. It should be recognized that precipitous flight to avoid an immediate threat is not panic so long as such behavior is controlled or directed away from danger. Indeed, instantaneous flight may be the best adaption for survival in many traumatic situations.

2. Major and persistent mental illness, such as psychoses, prolonged depressions and chronic neuroses are not produced by the psychological trauma of acute catastrophic events. The incidence of these psychiatric diseases was not increased by frequent aerial bombardment in England, Germany, and Japan during World War II.[10,11,12] Nor did such cases arise in any appreciable numbers from conventional combat, civil disasters, and the atomic destruction of Hiroshima and Nagasaki. Apparently, the classical mental disorders are caused mainly by internal psychic conflict rather than external danger.

3. A temporary breakdown of self-control is the characteristic and most frequent psychiatric abnormality noted in traumatic situations.[13]

This transient mental disorder is a direct

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consequence of external stress and commonly occurs during or shortly after the danger impact although cases may originate in the anticipatory period of threat prior to actual trauma. Individuals so affected exhibit disturbances of function that vary in severity from stunned mute behavior or uncontrolled purposeless movement, to trembling helplessness, apathetic depressed states, inappropriate activity, or preoccupation with bodily discomfort due to increased emotional tension. Typically, such disorders are fluid, changeable and self-limited, lasting for minutes, hours, or days.

4. Most, but not all persons experience disagreeable somatic and/or psychic sensations of fear when exposed to severe external danger.[14, 15]

The presence of fear does not prevent effective and even courageous activity. However, the accompanying subjective discomfort of fear can only hinder rather than aid the individual in his adaptation to a stressful environment. It is believed that a sufficient intensity of fear with its painful inhibitory effect is the usual precursor out of which arises the temporary mental disruption that is characteristic of major trauma. Therefore, measures to reduce the incidence of fear reactions are of vital importance in the prevention of non-effective behavior due to psychological reasons.

5. States of increased apprehensiveness frequently follow intimate personal involvement with catastrophic trauma.[16]

These residual reactions exhibit undue sensitivity to these external stimuli which can be associated with the previous traumatic episode. Usually such apprehensiveness does not prevent effective function, but in some persons the resultant increased level of anxiety produces insomnia, heightened irritability, poor appetite, weight loss and diminished work efficiency that may persist for many weeks. Individuals with severe apprehensiveness may absent themselves from work in a potential target area or seek relief by moving to a place of presumed safety. Residual anxious states are most apt to arise in persons who suffered intense fear, helplessness, or emotional breakdown during the traumatic event. In most individuals, such chronic apprehensiveness gradually diminishes over a period of weeks or months.

6. Docility and increased suggestibility are common behavioral characteristics of persons under disaster conditions.[17]

The fact that most participants of a dangerous or threatening situation can be readily influenced has important implications for the employment of communication facilities and leadership in the prevention of non-effective behavior.

The material thus far presented clearly indicates that the principal psychiatric problems produced by intense danger include temporary states of mental breakdown and residual sequelae of chronic apprehension. Similar psychological difficulties should be expected in atomic warfare. Before considering the management of the above psychiatric disorders, it will be profitable to explore the mechanisms of behavior under stress in order to establish a rational basis for the methods of prevention and treatment that are proposed in this presentation.

Behavioral responses to environmental change can be regarded as a function of the communication process both within and outside the person. For explanatory purposes, the individual's communication or mental process relative to external stimuli can be divided into three sequential time phases, namely perception, evaluation, and initiation of action. Usual or innocuous environmental changes generally evoke rapid appropriate responses when needed, in which the evaluatory component of the mental process plays little or no role as such, because of automatic decision making mechanisms that have been established by prior learning. However, new and abrupt external change requires the function of evaluation and, consequently, there is an appreciable time lapse exhibited by most persons in their response to unusual stimuli. When an abrupt environmental change is associated with a serious threat to life, the mental process is significantly altered so that the response may be either accelerated or inhibited. This well-known and seemingly

paradoxical phenomenon has been explained[18] by assuming that danger first produces an alerting action which operates simultaneously upon the several components of the mental process to: (1) focus attention only upon the pertinent elements of the threatening environment, thus narrowing the field of perception; (2) facilitates evaluation so that rapid decisions can be made; and (3) mobilizes the bodily systems for heightened and sustained activity. In brief, the alerting action is an effective biological mechanism which prepares the person for the traditional flight or fight patterns of behavior that are necessary for survival under dangerous conditions.

When an individual cannot cope with the threat either because of its magnitude, or other unalterable circumstances, or lack of confidence, then the urging force of alertment continues to press for action and reaches awareness as the distressing somatic and mental sensations subsumed under the term, fear. Fear operates to inhibit the mental process, perception becomes uncertain, and evaluation more difficult. Even minor decisions cannot be made, as exemplified by the frequent occurrence of docility and suggestibility noted among disaster victims. Similar inhibitory phenomena occur in the bodily sphere, as evidenced by weakness of the extremities, giddiness, constricted speech, and labored or difficult respiration.

On the basis of the above concepts supported by observations of combat and civil disaster, behavior under sudden impact of danger can be reconstructed as follows: In approximately 15-25% of persons subjected to an abrupt threat, prompt purposeful responses are evoked which continue into sustained effective action.[19,20] These aggressive individuals apparently have an increased capacity for utilizing the facilitory properties of alertment to quickly grasp the relevant details of a dangerous situation and make rapid appropriate decisions which are promptly translated into immediate action. Such effective participants are usually "too busy" to remember experiencing subjective fear during the emergency period, although soon after the danger has passed, some may note fear reactions upon contemplating a narrow escape, while others seem excited or even elated as they repeatedly discuss the events that have recently transpired.

The remainder and majority of persons confronted with sudden danger are stunned and bewildered as they require an appreciable time interval to evaluate the threatening situation during which there may be quick involuntary turning or crouching due to alertment. With the passage of varying but usually brief periods of time and a consequent better grasp and evaluation of their surroundings, most persons regain sufficient self-control to permit rapid goal-directed efforts such as movement away from danger. Military experience strongly indicates that with resumption of purposeful activity, fear is diminished or dissipated. When an individual responds correctly to the urging demands of danger, tension is discharged. Conversely, inaction under threatening circumstances fosters the building up of fear which further increases interference with internal communication and thus a vicious cycle is established with worsening behavior.

Psychological breakdown occurs in individuals subjected to severe trauma who are unable to respond with appropriate evasive or aggressive action and cannot tolerate the consequent intense fear or feeling of catastrophic disorganization. Individuals so affected do not suffer a literal breakdown of mental function, but regress to a more primitive behavioral pattern that permits a decrease of personal involvement with intolerable reality even though such behavior may be deleterious insofar as survival is concerned. The mute stunned reaction, common in disaster, illustrates the meaningful nature of these stress-induced psychiatric casualties. Here the involved person is seemingly isolated from the chaotic situation by the apparent blocking of all incoming stimuli. Such cases are described as blank, unemotional, dazed, unresponsive to questions and oblivious of painful injuries that may have been incurred.[21]

Less severe forms exhibit childish depend-

ent behavior manifested by helplessness, trembling, hysterical paralysis or marked docility.

Attention can now be directed to multiple elements of the traumatic situation which influence the frequency of psychiatric casualties.

1. Intensity and duration of the external trauma. Increasing magnitude of danger reduces opportunities for effective response and thus a greater likelihood of fear reactions and psychiatric casualties. In traumatic situations of brief duration, favorable conditions are soon re-established for the resumption of effective behavior whereas with prolonged danger, it is increasingly difficult to maintain appropriate activity and thus a higher incidence of fear and psychological disorders is to be expected. Associated with the intensity of danger is the degree of personal involvement experienced, such as being knocked down by blast, buried in rubble, injury by flying missiles and the like, which has given rise to the concept of the "near miss," and the "remote miss."[22] Military and civil stress situations are replete with examples which demonstrate that the "near miss" experience is far more terrorizing than the "remote miss" episode which in contrast tends to promote confidence that the particular danger can be successfully mastered. Often present in a "near miss" event is the sight of mangled bodies, mutilation, and other injuries which are even more devastating when loved ones, friends, or buddies are involved. "Near miss" experiences which are not accompanied by observation of injured casualties can be more easily tolerated.

2. Preparation and training. It has been pointed out that failure of an adequate response to danger evokes inhibitory fear reactions that render the exposed individual vulnerable to psychological breakdown. Clearly, a built in or previously prepared appropriate behavioral response is required in most persons for effective adaptation under traumatic circumstances. Such preparation and training should include measures to be taken immediately upon awareness of atomic attack as well as evasive or defensive precautions that can be employed in any warning period that may be made available. Training of this type is similar to that required for fire, gas attack, ship disaster at sea, and other emergency situations where there is insufficient time for evaluation and a pre-set pattern of action is of prime necessity to prevent indecision, and helplessness. Training should also include sufficient knowledge of the effects of atomic weapons, the fall out problem, and practical field methods of personal protection. Equipped with this information, the individual again deals with a predictable environment which, no matter how terrifying, is less fearful than unknown danger. From the standpoint of prevention the single most important favorable influence upon behavior in atomic stress lies in training and preparation for such an eventuality.

3. Warning. Even a brief warning period can enable prepared and disciplined groups to partially execute planned protective measures, along with mobilization of pre-set behavior for prompt action following the nuclear explosion. For untrained persons, a short period of warning before attack may precipitate indecisive flight or fear-induced paralysis, either of which is deleterious for effective function or survival. Untrained groups necessarily require a longer warning interval in order to gain sufficient distance from the target area or receive information as to the best possible protection that can be employed under the existing circumstances.

4. Communication. Human beings are poorly endowed insofar as sensory organs are concerned for the perception of danger unless their immediate surroundings have been radically altered. Significant minor or gradual changes are commonly overlooked or attributed to innocuous events in order to deny sources of anxiety that would disturb emotional tranquillity. To evercome deficiencies in human perception, sensitive mechanical means of detection have been devised, but a communication network is needed to transmit the data thus obtained to all per-

sons concerned. It should be apparent that much depends upon the efficiency of the communication system to transmit timely and accurate information.

Like perception, the evaluatory portion of the mental process is also commonly impaired under stressful conditions. Here too, communication can be a major influence in determining behavior by transmitting pertinent information required for adequate evaluation of the traumatic situation or by directing the specific action to be taken. Under stressful circumstances, experience has demonstrated that not only must the clarity and specificity of information furnished be of a high degree, but messages should be frequently repeated in order to counteract the disorganizing effects of fear which interfere with capacity for retention or recall of recent memory.

5. Leadership. In emergency circumstances, the leader may be regarded as an essential link or agent of the communication system who interprets transmitted information together with data gathered directly from the environment and indicates to others by word and action the proper responses and behavior to be followed. Since persons under stress exhibit a temporary impairment of communication with the environment or within their own mental organization, they seem to be in poor contact with their surroundings and manifest a high degree of indecision, docility, and suggestibility. Under these conditions, the demand for guidance and information is so great that leaders would arise even if they are not formally designated. In fact, such "emergent" leaders have been regularly noted in civil disasters as well as in combat.[23]

6. Group identification. Previous traumatic experiences indicate that individuals are better able to tolerate danger in the company of others who are similarly involved. In fact, persons confronted with a common menace literally and figuratively move toward each other for mutual protection and support. This phenomenon has been regularly noted in combat and was also reported from England during World War II where community shelters were preferred over individual types of protection, despite the added personal discomfort.[24] From the standpoint of communication, members of the group serve each other as verbal and non-verbal sources of information that may initiate and maintain constructive activity or provoke apprehension and precipitate non-effective behavior. With continued sharing of common hardships and danger, there is produced a cohesiveness or unity of group members which in military operations have been found to exert a powerful influence for effective function during severe stress. Such group identification establishes a code of conduct that continues to operate even under catastrophic conditions. In effect, group unity tends to correct for personality inadequacies such as egocentricity, timidity, seclusiveness, and lack of consideration for others.

Prevention. From the foregoing discussion of elements in the traumatic situation which influence behavior, it is evident that measures to lessen psychiatric disorders in atomic warfare lie within the province of command and cannot be a primary medical function. In this respect there is no essential difference between preventive psychiatry and other programs of preventive medicine in the military service which also require implementation that can only be initiated and maintained by command decision. The medical officer serves as a technical adviser to the commander in matters of physical and mental health. It is herein submitted that as part of this staff function, the medical officer should be familiar with the determinants of behavior under adverse circumstances in order to point out areas where remedial action is indicated and to perform such other advisory duties as may be necessary to assist the commander in conserving the effective strength from a psychological standpoint.

Treatment. In considering the treatment of psychiatric casualties, it is important to reiterate the recognition that these temporary states of mental disruption are acute fluid adaptive reactions to danger which are

self-limited and can be expected to begin improvement with the cessation of external threat. Methods of treatment herein proposed are derived from considerable experience with similar emotional disorders of combat[25] and are based upon the following operational principles:

1. Decentralization. This axiom of therapy insists that treatment facilities be made available as soon as possible and as near as practicable to the scene of atomic disaster. Benefits that can be expected from a policy of decentralization include the following:

a. Treatment can be given early, during the fluid state when psychiatric casualties are readily influenced by suggestion and other simple measures to recover self-control thus circumventing the effect of time and continued helplessness from causing a fixation of the inability to overcome danger that is mainly responsible for sequelae of chronic apprehension.

b. Psychiatric problems are prevented from further taxing evacuation channels and hospital facilities which will be fully occupied with the physically injured.

c. Rapid restoration to duty at this level can provide man-power who are urgently needed for defense and rescue.

2. Expectancy. This principle of therapy refers to the importance of verbal and non-verbal communication addressed to patients by treatment personnel. It is based upon the previously stated marked suggestibility and indecision exhibited by psychiatric casualties. Thus, military experience demonstrates that situationally induced acute mental disorders worsen or improve depending upon what is expected of them by persons responsible for their treatment and disposition. A treatment environment which communicates tension, helplessness, or disability continues symptoms and non-effective behavior. Conversely, a calm acceptance of the patient and his manifestations as a temporary incapacity from which rapid recovery is expected after a brief rest, can produce the desired improvement within hours, particularly when supervised or directed activity is promptly instituted to further confirm expectancy for recovery. Non-verbal attitudes and actions are far more effective than words in breaking through the communication barrier of patients. Expectancy for recovery is also communicated by the terms used to designate those disorders. Emotionally charged terminology such as shell shock, psychoneuroses, concussion, blast injury, and the like imply severe mental or physical damage from which recovery is uncertain and residual defects are probable. Already the term radiation sickness has become quite well known and could readily come into widespread use as a catch all category for all manifestations in atomic warfare which do not fit a known medical entity. It is, therefore, imperative that terminology such as combat fatigue be continued for psychiatric casualties in atomic warfare since this designation fosters expectancy of a transient benign disturbance due to logical situational causes which is readily recoverable and leaves no permanent defect.

3. Brief simplified methods. Any prolonged or involved treatment program either could not be adequately performed at a decentralized level or if attempted, would nullify the principle of expectancy by its implication of an illness sufficiently serious to warrant such an elaborate effort. Prior experience with complicated treatment techniques which rely upon drugs, prolonged bed care, subshock insulin, or frequent psychiatric interviews have indicated that only mediocre results were obtained despite the large outlay of personnel and supplies. On the other hand, a brief rest of several hours, along with measures to alleviate hunger, pain, and minor injury when performed at a decentralized level in an atmosphere of expectancy for recovery, provide the most favorable conditions for a resurgence to functional capacity. Drugs should be used sparingly and in small doses. Relaxation can be obtained with warm drinks of milk, cocoa, soup and the like. If time permits, there should be included, a brief interview period in which the patient is allowed to give freely his account of the traumatic event in order to facilitate the ventilation of emotionally charged

feelings and attitudes that may be responsible for maintaining withdrawal from painful reality. Ventilation aids in re-establishing communication with the patient who can then receive information and be motivated to participate in the rescue or defense effort. The last step of simplified treatment is directed or supervised work. With resumption of purposeful activity, communication is further improved, and reorientation to group and social obligations is facilitated.

A sufficient number of psychiatrists neither will be available for the management of mass psychiatric casualties nor does the operation of a simplified program require the services of such specialists. From the traditional military standpoint, the control of behavior under battle conditions is necessarily the responsibility of all persons charged with the function of leadership and medical care. As in previous warfare, milder instances of "freezing," indecision, helpless attitudes, or inappropriate activity can be best handled by commissioned and non-commissioned officers, buddies, and medical corpsmen who are optimally located in time and space to favorably influence or direct temporarily disorganized persons by word and action to assume a more effective role. The more persistent psychiatric casualties should be treated at the nearest medical facility which in a tactical situation is usually the Battalion Aid Station. If nuclear weapons are used against support or rear zones, it is likely that a hospital facility would provide immediate medical care.

In either event, the prompt treatment and restoration to duty of psychiatric casualties should be a recognized responsibility of the first medical facility to receive early cases of this category. In atomic warfare, the battalion surgeon must assume more and more the role of a front line psychiatrist in order to conserve the effective strength of his unit at a time when every man is vitally needed. Medical evacuation under such conditions will be difficult procedure at best and initially should be reserved for the physically injured. Severe or persistent cases can be sent to the division psychiatrist at the clearing station level when transportation is available. The division psychiatrist should serve also as a professional consultant to other medical officers and advise commanders in ways and means of preventing psychological disorders.

It is recommended that a provisional psychiatric and welfare section be established in any hospital that becomes a front line medical unit due to nearby atomic attack. Such a function should be located adjacent to the main facilities for the physically injured and operate with a minimum of equipment and personnel. This action can be staffed by Medical Service Corps Officers trained in social work and clinical psychology, Red Cross personnel, chaplains, and several enlisted technicians along with a nurse to care for minor injuries. The assigned psychiatrists should serve only as consultants to this section, for as medical officers, their services can be more profitably utilized in the treatment of physical casualties. After the emergency period has passed and the hospital situation has stabilized, psychiatrists as well as other specialists should resume their characteristic medical function.

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The Cost of Delayed Medical Care*

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THIS study represents a careful evaluation by the authors of the over-all problem of the surgical care of traumatic and thermal injuries of atomic casualties. Badly needed data is not yet available. Although this paper has been painstakingly assembled, its purpose will not have been fulfilled if it fails to stimulate the medical services to a more careful appraisal of the subject. In this regard, we should like to commend the leaders of the Army Medical Service Graduate School (now Walter Reed Army Institute of Research) for their foresight and perseverance in improving the care of the injured soldiers.

GENERAL CONSIDERATIONS

One hour after the bomb has fallen, 35,000 casualities are injured to an extent sufficient to require hospitalization. We must appraise this problem from the standpoint of mortality, morbidity, professional and financial costs. The figure of 35,000 casualties is an arbitrary number, to be multiplied by whatever factor is deemed necessary.

We have already assumed a theoretical, and limited, triage in our selection of the figure of 35,000 in need of hospitalization. What can we expect in the way of mortality if casualties are left untreated?

The United States Strategic Bombing Survey,[1] writing of the observations made at Hiroshima and Nagasaki, state that little effective medical care was rendered within the first week. In terms of mortality, therefore, this would imply that few lives were saved by medical care. Their estimate was that only 5-8 percent of deaths could have been prevented by good, early treatment. Since they estimate the number of deaths at about 80,000 and the number of injured 80,000 to 100,000 at Hiroshima, this would imply that an additional 5-8 percent of the W.I.A. (or 2.5-4.0 percent of the total K.I.A. and W.I.A.) might have been saved by prompt treatment. Thus, 5 percent of 35,000 casualities would be 1,750 casualities who might live or die depending on the adequacy of their treatment (Table I).

The vast majority of those who die of wounds, die shortly after injury. Early and adequate treatment affects the late mortality much more than it does the early mortality.

If we assume that treatment of the wounded in the Crimean War of 1854-56 saved very few lives and that the salvage in World War II approximates the salvage we can hope for today, we find that the percentage of Wounded in Action who die within the first 24 hours is almost independent of the surgical care,[2] except perhaps from the control of external hemorrhage (Figs. 1 and 2). These figures indicate that care within 24 hours, and indeed care within 48 hours, keep very few casualties from dying during the first 48 hours. And yet, improved surgical care resulted in lowering the total mortality of the W.I.A. from approximately 17% in the Crimean War to approximately 4.5% in World War II (Figure 2), an additional salvage of 12.5%. This 12.5% difference (or 4,375 casualties) represents the group which might be saved by treatment. The Strategic Bombing Survey estimate would imply that in our specific problem, approximately half of this group might be saved by early, ade-

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TABLE I. INJURED SALVAGED BY TREATMENT

Number of Casualties	Salvage Due to Adequate Treatment	Total Salvage Due to Treatment	"Savings in Dollars"	
			at $10,000 each	at $100,000 each
35,000	5%	1,750	17,500,000	175,000,000

quate care. The difference in the two estimates reflects the inadequacies in the treatment of thermal and radiation injuries.

The mortality at the forward surgical hospitals in Korea was reduced to approximately 2.4 percent. Treatment, at least on the Eastern Front, was usually possible within 12 hours after injury. If we apply the factor of 1.3-1.6[2] to include the estimated number dying in medical installations forward and to the rear of the surgical hospital, we estimate a mortality of approximately 3.6 percent following early definitive treatment in Korea.

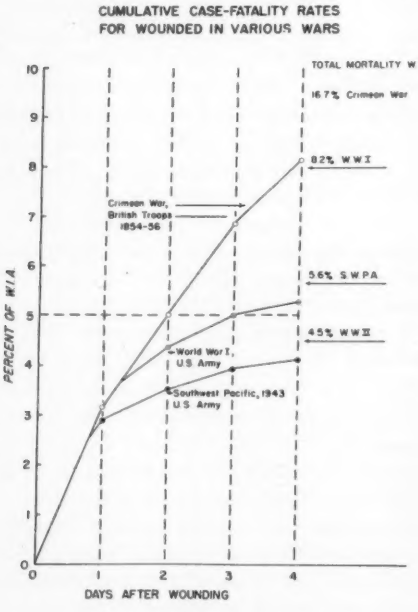

FIG. 1.

If we accept an early mortality* of 3.8% for treatment within the first 12 hours, distribute the mortality over five 12-hour periods as in Table II, and assume that the immediate mortality among the untreated is twice that among the treated,[2] we again find that the early mortality would not be tremendously increased by early care. This illustration consists of five identical samples of wounded whose care is begun at 12-hour periods after wounding. The mortality for those treated within the first 12 hours would be constant, 3.8%. "However, by virtue of the exclusion of the early deaths, samples No. 2 to 5, which involve progressive delay in treatment, have lower apparent mortality rates. In each instance 1,000 men are wounded but in the first, all men are picked up in the first interval and the deaths are 20 in that interval, and 10, 5, 2 and 1 in succeeding intervals, making a mortality rate of 3.8%. In the second sample, the untreated have twice the mortality they would otherwise have had in the first interval, but the treated survived as well in the second and subsequent intervals. If the mortality rate is computed from the point of pick-up rather than from the time of wounding, the mortality rate of 5.8% is reduced to 1.8%. The divergence is more extreme the longer the delay in bringing the wounded under surgical care."[2]

Thus there is a reasonable basis for believing that late therapy would not tremendously alter the early mortality rates, especially if half of the casualties were treated early, half late. Early deaths result from the magnitude of the trauma and from blood loss. Early treatment is essential in saving the maximal number of lives, but compared to the magnitude of our problem, the percent reduction in mortality would be small.

* Adapted from Beebe and DeBakey (2), p. 98-99.

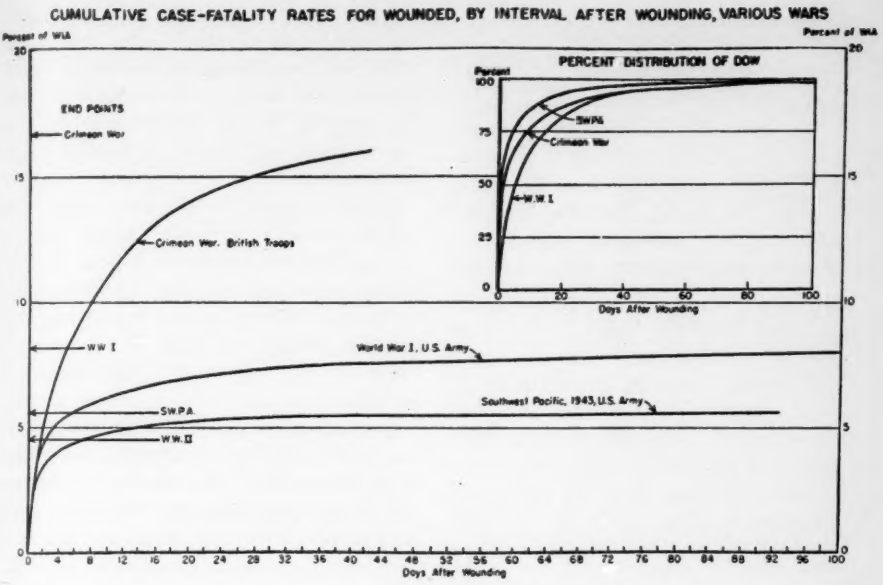

FIG. 2.

What about the morbidity due to infection?

Meleney,[3] summarizing the findings in a study of 926 soft tissue wounds and 674 compound fractures, found the incidence of infection to be 17.6% for the soft tissue wounds and 25.5% for the compound fractures (Table III).

Serious infections were defined as those producing systemic manifestations, further destruction of tissue, or materially prolonging wound healing or hospitalization.

TABLE II

Plan	Number Wounded	Interval to Treatment (Hours)	Number Treated	Deaths After Wounding							Percent Dying	
				By Intervals (Hours)					All Intervals	After Treatment	Among 35,000	Among those Treated
				12	24	36	48	60				
1	35,000	12	35,000	700	350	175	70	35	1,330	1,330	3.8*	3.8
2	35,000	24	33,600	1,400	350	175	70	35	2,030	630	5.8	1.8
3	35,000	36	32,900	1,400	700	175	70	35	2,380	280	6.8	0.8
4	35,000	48	32,550	1,400	700	350	70	35	2,555	105	7.3	0.3
5	35,000	60	32,140	1,400	700	350	140	35	2,625	35	7.5†	0.1

∴ During this period, the mortality might be increased, as time lag was increased by 3.7%—or approximately 100% (or an added loss of 1,295 patients).

Adapted from Beebe and DeBakey

* A reasonable figure by comparison of all wars (Figure 22—Beebe and DeBakey). Among 773,935 wounded in W.W.II—7 December 1941–31 December 1945—3.4% D.O.W., 22.7% K.I.A.

† Compares with a mortality for the Crimean War (1854–56) of approximately 6% at the end of 60 hours (Figure 2).

TABLE III. INFECTION IN SOFT TISSUE WOUNDS AND COMPOUND FRACTURES

Infection	Soft Tissue (926 patients)	Compound Fractures (674 patients)
Serious infections	6.4%	14.1%
Trivial infections	11.2%	11.4%
Total	17.6%	25.5%

This was a study of debrided wounds. Being treated in civilian hospitals, they were doubtlessly debrided early. Meleney found no evidence, in controlled studies, that sulfonamides reduced the incidence of wound infection, but felt to the contrary, that those wounds were all contaminated and that infection was dependent upon the inadequacy of debridement. Note that in spite of early debridement the incidence of infection was high.

In the same study of 591 patients with second and third degree burns, the incidence of infection was found to be 46.5% (Table IV). In the patients with third degree burns, the incidence of infection was 67.9%. These infections can seldom be prevented by attention to the wound or by antibiotic therapy. The essential factor, debridement of nonviable tissue, can seldom be applied to the burn wound.

TABLE IV. INCIDENCE OF INFECTION IN 591 BURNS

Infection	Second Degree Burns	Third Degree Burns	Total
Serious infection	8.1%	35.5%	21.8%
Trivial infection	17.0%	32.4%	24.7%
Total	25.1%	67.9%	46.5%

Large, avulsive wounds are contaminated wounds, contain nonviable tissue, and will become infected unless debrided. The incidence of infection in the 16,800 casualties with major lacerations and fractures, if not debrided during the first 24-48 hours, is unknown but must surely approximate 50 percent.

In the latter half of the Korean conflict, the incidence of gas gangrene on a general surgical service at a forward hospital was 0.08% and the mortality was zero. Early debridement and antibiotic therapy were routine (Table V). This represents quite a difference from the earlier experiences (Tables V, VI) in World Wars I and II. Coupal[4] reported an incidence of gas gangrene of 1.1% and 5.2% for soft tissue wounds and compound fractures among American troops in World War I. Pettit[8] wrote of the more seriously injured of the St. Mihiel and Argonne-Meuse operations in World War I when a hospital received 4,377 casualties over a 2-month period, the time lag often being as long as 48 hours. These conditions as to time lag are pertinent to our problem today. Pettit wrote that of the 4,377 patients, 221 or 5% developed gas gan-

TABLE V. CLOSTRIDIAL MYOSITIS (GAS GANGRENE)

	World War I Evacuation Hosp. No. 8, 10 Sept. 1918–13 Nov. 1918	World War II Hospital, India (17)	Korean War 46th Surg. Hosp., Jan. 1952–June 1953
Number of Casualties	4,377	4,600	4,900
Number Developing Clostridial Myositis	221	32*	4
Percentage Developing Clostridial Myositis	5.0%	0.7%	0.08%
Case Fatality Rate	27.6%	31.3%	0

* An additional 37 patients developed serious clostridial wound infections, making a total incidence of serious infection by *Clostridium perfringens* of 1.5%.

TABLE VI. GAS GANGRENE IN WORLD WAR I

Type of Injury	Number of Casualties	Incidence of Gas Gangrene	Mortality
Soft tissue	128,265	1.1%	48.5%
Compound fractures	25,272	5.2%	44.6%

grene. This presumably represents approximately 10% of the casualties with wounds of the extremities. The mortality of such infections was 27.6%.

Treatment was often delayed, inadequate by present day standards, and without antibiotics. Altemeier and Furste,[5] however, observed that in experimental animals, penicillin prolonged life but did not greatly alter the mortality if the wound was not treated. Altemeier[6] further described the average incubation period for gas gangrene (Cl. perfringens) as 24 hours and Trueta[7] states that "an untreated patient who survives 48 hours or longer without signs of anaerobic infection will probably escape gas gangrene."

Thus surgery within the first 12 hours can effectively prevent gas gangrene whereas casualties, in the selected group of fractures and major lacerations, coming to surgery at 24-48 hours may have established gas gangrene in an incidence approximating 5% or possibly 10%. The amputation rate which must follow in the treatment of the infection may also approach 5-10% although the figure of 3% might be a better estimate. The resultant case fatality rate is unknown but should be low.

The incidence of tetanus in untreated casualties is unknown but must be fairly low. Prior to the use of antiserum, the incidence was 0.2% in the American Civil War, and 0.8% in the Franco-German War and among the British of the early phase of World War I (Table VI-A). The Germans reported an incidence of 0.38% for World War I.[23] These casualties had wound surgery but no other specific treatment. To the contrary, among the malnourished, neglected civilians under siege in Manila, Glenn[21] estimated the incidence of tetanus to be 4.0%. The last group had no wound care beyond the application of a tourniquet.

The mortality in Manila, among those

TABLE VI-A. INCIDENCE OF TETANUS IN MILITARY CAMPAIGNS

War		Years	Number of Casualties	Incidence of Tetanus (per thousand casualties)
American Civil War	(21)	1861–1865	246,172	2.07
Franco-German War	(22)	1870–1871	—	8.0
World War I British Troops	(22)			
Before Antiserum		1914–1915	—	8.0 } 1.47
After Antiserum		1915–1918	—	1.0 }
World War I German	(23)	1914–1918	4,000,000	3.8
World War II American	(24)	1941–1945	2,500,000	0.006
World War II Manila Civilians	(21)	1945	—	40.0*

* Estimated.

casualties with tetanus receiving late treatment, was 82%; among the Germans of World War I, 80%.

Basic immunization including a booster toxoid injection prior to combat and followed by an emergency booster after injury offers an effective, almost complete, prophylaxis against tetanus.[24] Aureomycin has been demonstrated to have a very modest prophylactic effect in the unwounded animal and Altemeier[26] has indicated that penicillin has no therapeutic effect in this disease in humans.

The problems will therefore largely be among the civilian casualties although every reasonable effort should be made to provide troops with a booster injection within the first two days for the antibody response requires about five days, clinical tetanus about five to seven days.

Antiserum, administered early to the civilians, might result in a reduction in incidence parallel to the British of World War I: from 0.8% to 0.1%.

There is inconclusive evidence to suggest that antibiotics may affect the incidence of the development of tetanus in the undebrided wound, although this observation has apparently not been made in man. Another observation which is mandatory is the effect of irradiation on the antibody response.

What of the requirements of manpower for the management of 35,000 patients? Beebe and DeBakey[2] estimated that the operating load of 7 casualties per 24 hours could be increased during a peak load for 3 days to 10.5 casualties per day. No single anesthesiologist or anesthetist could well care for a greater number. Thus 35,000 casualties, to be cared for in 24 hours, might require 3,333 surgeons and an equal number of anesthetists (Table VII).

If instead of treating all the casualties within the first 24 hours, we divide the casualty load over 48 hours, the professional requirements would hardly be cut by 50% as the deterioration of the patients with the resulting increase in necessary care and professional man hours would more than offset the decreasing load due to intervening deaths.

TABLE VII. PERSONNEL REQUIREMENTS FOR CARE WITHIN 24 HOURS

	No. Casualties Per 24 Hours	Total No. Casualties	No. Specialists Required
Surgeons	10.5	35,000	3,333
Anesthetists	10.5	35,000	3,333

The mean time for hospitalized battle casualties has been reported as 54[2] and approximately 60 days.[20] The average period for burned patients in a civilian hospital was 90 days.[15] Early care might, therefore, result in a total period of hospitalization which we would estimate at 2,625,000 days (Table VIII). If we assume that late care increases the case fatality rate of the traumatic casualties by 12.5%, increases the period of hospitalization of traumatic casualties due to infection by 50%, increases the case fatality rate from the thermal injuries 15-20% but does not increase appreciably their incidence of infection, we might estimate the total period of hospitalization fol-

TABLE VIII. CUMULATIVE DAYS OF HOSPITALIZATION FOLLOWING EARLY TREATMENT

Type of Casualty	Number of Casualties	Estimated Days of Hospitalization (Per Casualty)	Total Days of Hospitalization
Traumatic	17,500	60	1,050,000
Thermal	17,500*	90	1,575,000
Total	35,000	—	2,625,000

* Includes traumatic injuries complicated by burns.

TABLE IX. CUMULATIVE DAYS OF HOSPITALIZATION FOLLOWING DELAYED TREATMENT*

Type of Casualty	Number of Casualties	Estimated Days of Hospitalization (Per Casualty)	Total Days of Hospitalization
Traumatic	15,300†	90	1,377,000
Thermal	14,500‡	90	1,305,000
Total	29,800	—	2,682,000

* Assuming all casualties were treated late.
† Based on an increase in immediate mortality of approximately 12.5%.
‡ Based on an increase in immediate mortality of 17–18%.

lowing delayed therapy at 2,682,000 days (Table IX).

The current cost of hospitalization in military hospitals, Class I, is $19.08 per day; in Class II hospitals, $17.72 per day.[20]

Early care might thus cost an estimated 47 million dollars in hospitalization, late care approximately the same in terms of hospitalization only (Table X). The added loss from amputations, however, would be tremendous (Table Xa).

Since definitive surgical care cannot be provided 35,000 casualties within 24 or 48 hours, establishment of priority for early treatment might best be approached by estimation of results of treatment and personnel requirements for wounds of various anatomical area.

TABLE Xa. COST OF DELAYED MEDICAL CARE* AMPUTATIONS DUE TO DELAYED CARE

	Additional Number of Amputations	Cost Per Limb	Added Cost
Gas Gangrene†	504	$100,000	$50,400,000
Vascular Injuries‡	182	$100,000	$18,200,000
Total	686	—	$68,600,000

* Assuming all casualties were treated late.
† Assuming an increased amputation rate of 3% among the wounds of the extremities.
‡ Assuming 80% salvage with early operation, 25% salavage with prolonged use of tourniquets and delay in operation.

CONSIDERATIONS BY ANATOMICAL SITES OF INJURY

Wounds of the Central Nervous System. Matson,[10] summarizing the experiences of World War II with penetrating wounds of the brain, makes the following statement: "Contrary to previous observations, in the recent war the age of the wound at the time of operation, up to 48 to 72 hours, made little difference in the incidence of infection or the mortality. Therefore, criteria other than the time-lag from wounding are more properly used to determine priority for surgery during this period, providing the patient is receiving adequate supportive treatment and chemotherapy."

TABLE X. ESTIMATED COST OF HOSPITALIZATION

Time of Treatment	Total Number of Hospital Days	Cost per Day	Total Cost
Early care	2,625,000	$18.00	$47,250,000
Late care	2,682,000	$18.00	$48,276,000

The case fatality rate of penetrating wounds of the brain, in his collected series, was 25% of the W.I.A. and 14% of those operated upon (Tables XI, XII). These figures indicate that approximately 10% of the casualties were inoperable or died prior to operation.

In contradistinction to Matson's conclusion, the experience of the 2nd Auxiliary Surgical Group in World War II would sug-

TABLE XI. OVER-ALL MORTALITY OF PENETRATING BRAIN WOUNDS AT EVACUATION HOSPITALS, WORLD WAR II (FROM MATSON (10))

Hospital	Number of Penetrating Brain Wounds	Over-all Mortality
7th Army (13 hospitals)	1,176	27.8%
Evac. Hospital (Personal communication)	271	32.0%
Evac. Hospital (Personal communication)	252	24.0%
Evac. Hospital (Gaynor and Gurwitz)	190	25.8%
Evac. Hospital (Weaver and Frishman)	126	20.7%
Evac. Hospital (Shearburn and Milford)	—	29.0%
Average		25%

gest that delay did increase the mortality (Table XIII), especially since they gave priority to the more seriously injured during the earlier hours.

The time lag would probably be of much greater importance in some of the closed

TABLE XII. POST-OPERATIVE MORTALITY OF PENETRATING BRAIN WOUNDS AT EVACUATION HOSPITALS, WORLD WAR II (FROM MATSON (10))

Source	Number of Penetrating Brain Wounds	Post Operative Mortality
1st Army (12 hospitals; five-month period)	1,102	14.8%
7th Army (13 hospitals; five-month period)	949	14.4%
Haynes	296	12.8%
Matson	202	13.2%
Gaynor and Gurwitz	156	10.8%
Munslow	140	17.0%
Weaver and Frishman	126	12.3%
Shearburn and Milford	122	12.3%
Tinsley	61	11.4%
Ascroft; British Army	292	15.0%
Slemon; British Army	239	14.7%
Average		14%

TABLE XIII. POST-OPERATIVE MORTALITY OF PENETRATING HEAD WOUNDS* WORLD WAR II—2ND AUXILIARY SURGICAL GROUP

Hours from W.I.A. to Operation	Total Cases	Deaths		
		Number	Percent	
Under 12	185	25	13.5	
12–17	74	7	9.5	12.8
18–23	70	10	14.3	
24–47	77	18	23.4	
48 and over	35	3	8.6	18.8
Unspecified	13	0	—	
Total	454	63	13.9	

* Forward Surgery of the Severely Wounded, p. 664.

head injuries and in many of the spinal cord injuries. Many of the injuries would be concussion in type and although they would not require operation, would require almost as much time and care.

Assuming that two neurosurgeons and an anesthesiologist could care for 10 patients per 24 hours:

1—To care for 2,625 patients within 24 hours would require 262.5 teams; within 48 hours, 131.3 teams (Table XIV). Because 10% might prove inoperable, this calculation for personnel might be reduced 10%.

These injuries require formal craniotomy. Few short cuts are possible. The hours of surgical manpower are high and the salvage fairly limited.

Thoracic Wounds. Few wounds limited to the thorax require formal thoracotomy. Open chest wounds must be closed; pneumothorax and hemothorax must be treated

TABLE XIV. PERSONNEL REQUIREMENTS FOR CENTRAL NERVOUS SYSTEM INJURIES

		Care Within 24 Hours	Care Within 48 Hours
Neurosurgeons—	3,131	525.0	262.5
Anesthesiologists—	3,115	262.5	131.3
Total		787.5	393.8

TABLE XV. THORACIC WOUNDS TIME-LAG VS. MORTALITY

Source		Number Casualties	Time-lag (Hrs)	Mortality
Thoracic				
Korea (11)		33	7.5 ave.	6.1%
5th Aux. Group (WW II)	(2)	132	12 or less	7 % } 7.8%
5th Aux. Group (WW II)	(2)		over 12	30 % }
Thoraco-abdominal				
Korea	(11)	29	7.9 ave.	10.3%
2nd Aux. Group (WW II)	(2)	903	—	27 %

by aspiration or tube drainage. Tracheotomy may be required. The average operative time per patient required in Korea was 1.6 hours.[11]

The hemothorax is probably never completely cleared by such means so that immediate treatment vs. treatment after 24 hours will probably not influence greatly the incidence of empyema. The difference will be in the treatment of mechanical defects and blood loss. The mortality at one forward surgical hospital in Korea was 6%[11] (Table XV). This was not appreciably different from the results in World War II.[2] The experience of the 5th Auxiliary Surgical Group in World War II would suggest a highly significant increase in mortality with delay in the treatment of thoracic wounds.[2] In their experience, the mortality of those treated within the first 12 hours was 7%, in those treated after 12 hours, 30%. Delayed treatment may therefore result in a profound, deleterious effect.

TABLE XVI. PERSONNEL REQUIREMENTS FOR CARE OF THORACIC INJURIES

	Care Within 24 hours	Care Within 48 Hours
General Surgeons (C 3150)	87.5	44

Personnel requirements for the care of these casualties might be estimated as follows:

1—A general surgeon might care for a maximum of 20 patients daily or 40 patients in two days.

2—To care for 1,750 patients within 24 hours might require 87.5 surgeons; within 48 hours, 44 surgeons (Table XVI).

This represents a maximal return on material and professional investment.

Abdominal Injuries. Early treatment of abdominal injuries in a forward surgical hospital in Korea resulted in a case fatality rate of only 12.6% (Table XVII). This was

TABLE XVII. ABDOMINAL INJURIES
Case Fatality Rate vs. Time-lag

Source	Hours to Surgery	Number of Wounded	Case Fatality Rate
Korea (11)	6.3 ave.	75	12.6%
World War II (2)*	0– 5	611	22.7%
(2nd Aux. Surg. Group)	6–11	1,399	21.7% } 23%
	12–17	506	25.3%
	18–24	200	25.0%
	24 or more	210	31.4%
Total		2,926	23.5%

* A calculated increase in case fatality rate of approximately 0.5% per hour.

in contradistinction to a case fatality rate of 23.5% reported by the 2nd Auxiliary Surgical Group in World War II.[2] In the latter report, the mortality for those casualties operated upon within 24 hours after injury was 23%, after 24 hours, 31%. Beebe and DeBakey[2] calculated an increase in the case fatality rate of approximately 0.5% per hour delay.

Applying the effect of delay on case fatality rates from World War II to our problem, we make the following calculations:

(a) 1,750 patients treated within 24 hours
23% case fatality rate

402.5 fatalities

(b) 875 treated within 24 hours
23% case fatality rate

201 fatalities

875 treated between 24-48 hours
31% case fatality rate

271 fatalities

201
271

472 fatalities

(c) 472 fatalities over 48 hour period
402 fatalities over 24 hour period

70 fatalities, or an increase in total case fatality rate of 3%

If we start with the case fatality rate of 12.6% from Korea, our total number of fatalities will be reduced.

Essentially all of these casualties will require laparotomy.

Operating time in Korea averaged 2.4 hours for the abdominal group, 2.3 hours for the thoraco-abdominal group.

Three operating groups, teamed together in a unit, might be organized as follows:

General surgeons C 3150 5
General surgeons B 3150 1
Anesthesiologists 3115 3

The maximal number of laparotomies per day per operating "table" would be 9, or 27 per unit.

To care for 1,750 patients with abdominal injuries within 24 hours would require 65 units; within 48 hours 32.5 units (Table XVIII).

It is hardly anticipated that this many laparotomies could be performed, because of professional and surgical shortages, but these casualties deserve a fairly high priority for early treatment.

Major Lacerations. The cost of delay in terms of wound infections has been discussed. The increase in mortality should be slight. The maximal number of casualties which could be operated on by a surgeon and anesthesiologist per 24 hours would be approximately 15-18 per day. Fifteen per day might be more realistic. The care of 12,500 casualties with major lacerations would require the services of 833 teams to provide care within 24 hours; 416.5 teams to provide care within 48 hours (Table XIX). Salvage would be primarily in the prevention of infection rather than in the immediate salvage of life. Hemostasis rather than debridement must be the practical early objective in this group.

TABLE XVIII. PERSONNEL REQUIREMENTS FOR CARE OF ABDOMINAL INJURIES

		Care Within 24 Hours	Care Within 48 Hours
General Surgeons	C 3150	325	162.5
General Surgeons	B 3150	65	32.5
Anesthesiologists	3115	195	97.5
Total		585	292.5

Orthopedic Injuries. The increased hazard of infection following delayed debridement has been discussed. The case fatality

TABLE XIX. PERSONNEL REQUIREMENTS FOR CARE OF PATIENTS WITH MAJOR LACERATIONS

		Care Within 24 Hours	Care Within 48 Hours
General surgeons	C 3150	833	416.5
Anesthesiologist	3115	833	416.5
Total		1,666	833

rate from Korea (Table XX) of 1.2% for fractures might not be greatly increased with delay but the rate of 9.7% for traumatic amputations doubtlessly would increase sharply. The latter injury might still be relatively frequent due to falling structures.

Many of the fractures would be closed injuries but the problems in handling the aged

TABLE XX. ORTHOPEDIC INJURIES—KOREA[11]

Injury	Number of Patients	Case Fatality Rate
Traumatic Amputations	31	9.7%
Open Fractures	82	1.2%

and the children would add to the time requirements.

Two orthopedic surgeons and an anesthesiologist working as a team might handle 20 patients per day. The care of 4,550 orthopedic patients within 24 hours would require 227.5 teams; within 48 hours, 114 teams (Table XXII). Correction of fractures, therefore, can hardly be achieved

TABLE XXI. ORTHOPEDIC INJURIES—KOREA[11]

Injury	Number of Patients	Average Time Per Patient Hours		
		Preparation	Operation	Total
Traumatic Amputations	31	4.2	1.6	5.8
Open Fractures	82	3.5	1.3	4.8

TABLE XXII. PERSONNEL REQUIREMENTS FOR CARE OF ORTHOPEDIC PATIENTS

	Care Within 24 Hours	Care Within 48 Hours
Orthopedic surgeons	455	228
Anesthesiologist	228	114
Total	683	342

early. Amputation of mangled extremities, since they threaten life rather than limb, deserves earlier surgery.

Vascular Injuries. The amputation rate following ligation of peripheral arteries in World War II was 48%.[12] Primary repair of these defects in the Korean theater demonstrated that repair within 12 hours of injury reduced the amputation rate to 7%, the mortality to 4%, and the incidence of gas gangrene to 1%.[13] The work in Korea demonstrated that repair could be successfully achieved as late as 18-24 hours after injury although the incidence of failure increased, a fact fully substantiated in the experimental animal (Table XXIII).[18] It is probable that at such a late hour, most limbs which remained viable to permit a successful anastomosis did so because of a rich collateral circulation. Ligation would probably have permitted survival of some of these limbs repaired after 18 hours.

The loss of a limb in a combat soldier costs the government $100,000.[14] Surgery within 24 hours might save approximately 80% of limbs; 350 patients $\times 80\% = 280$ limbs. Repair of 175 the first day (at 80%) would save 140, and 175 the second day at 25%

TABLE XXIII. RESTORATION OF CIRCULATION AFTER ACUTE ISCHEMIA[18] (DOGS)

Period of Acute Ischemia	Number of Experiments	Legs Survived
1– 6 hours	21	90%
12–18 hours	26	50%
24–30 hours	10	20%
No repair		0%

survival rate (because of frequent prolonged use of tourniquets) would save 44 limbs = 188 limbs. At $100,000 each, delayed surgery would cost 96 additional limbs or $9,600,000.

1—Immediate care after 24 hours would be somewhat limited to minor surgery as arterial surgery would seldom be feasible. A team consisting of one general surgeon B 3150, two general surgeons C 3150, and two anesthesiologists could care for a maximum of 24 patients daily.

2—The requirements for the care of 350 patients with vascular injuries would be 14.6 teams for care within 24 hours, approximately 7.3 teams for 48 hours (Table XXIV). Early surgery will hardly be possible beyond the control of hemorrhage.

TABLE XXIV. PERSONNEL REQUIREMENTS FOR CARE OF CASUALTIES WITH VASCULAR INJURIES

		Care Within 24 Hours	Care Within 48 Hours
General surgeons	B 3150	14.6	7.3
General surgeons	C 3150	29.2	14.6
Anesthesiologists	3115	29.2	14.6
Total		73.0	36.5

Maxillo-facial Injuries. Standard practice includes not only debridement but primary repair of these wounds.

Assumptions:

1—Since only the more seriously injured are admitted, few patients could be managed under local anesthesia; many would require endotracheal anesthesia. Moreover, many would require tracheotomy. Primary repair after 24 hours would hardly prove feasible.

2—The maximal number of patients which could be handled per 24 hours by a team of a surgeon and an anesthesiologist would be 10.

Results: 1—The management of 1,050 patients with maxillo-facial injuries within 24 hours would require 105 teams; within 48 hours 53 teams (Table XXV).

TABLE XXV. PERSONNEL REQUIREMENTS FOR CARE OF PATIENTS WITH MAXILLO-FACIAL INJURIES

	Care Within 24 Hours	Care Within 48 Hours
Surgeons (plastic)	87.5	43.8
Anesthesiologists	87.5	43.8
Total	175.0	87.6

Ophthalmic Injuries. Assumptions:

1—Many operations could be performed under local anesthesia but the number of children would limit this number.

2—A team of two surgeons and one anesthesiologist might manage a maximum of 30 patients a day (Table XXVI).

Results: 1—The management of 525 casualties with ophthalmic injuries would require the service of 17.5 teams for 24 hours; 8.8 teams for 48 hours (Table XXVI).

Burns. It is estimated that there would be 10,500 casualties whose essential injury will be thermal burns. The patients will have second and third degree burns of sufficient extent to require hospitalization.

Since these patients can seldom be debrided early, since antibiotics do not prevent infections in undebrided wounds, since all of these wounds will be contaminated at the time of hospitalization, early treatment will not materially affect the incidence of infection. Is early treatment necessary?

Ziffren,[15] in summarizing the results of the treatment of burns in civilian life, indi-

TABLE XXVI. PERSONNEL REQUIREMENTS FOR CARE OF CASUALTIES WITH OPHTHALMIC INJURIES

	Care Within 24 Hours	Care Within 48 Hours
Surgeons (eye)	35.0	17.5
Anesthesiologists	17.5	8.8
Total	52.5	26.3

TABLE XXVII. BURNS
Comparative Mortalities[15]

Years	Total Patients	Mortality
1930–40	66	28.7%
1940–50	149	16.1%

cated that advances in therapy had lowered the mortality. Based on a study of 215 patients he demonstrated the following comparative mortalities (Tables XXVII-XXIX).

He makes the following statement: "In no instance in this group of cases did a patient survive who had 45 percent or more of the body surface burned to a third degree depth. Immediate debridement under anesthesia had no effect on the mortality rate and neither did the administration of antibiotics. (This

TABLE XXVIII. MORTALITY OF BURNS[15]
The Acute Stage

Years	Number of Patients	Mortality
1930–40	13	53.8%
1940–50	31	35.4%

TABLE XXIX. THE ACUTE STAGE
Percentage of Body Surface Burned in Those Who Live and Those Who Died[15]

Years	Died	Lived
1930–40	63.1%	24.1%
1940–50	49.0%	27.5%

was not true in the chronic phase.)" In view of this common experience, the lowering of the mortality during the acute stage must have resulted from support of the blood volume. Since immediate operation has little to offer, delay in operation will not be a loss. Therapy must be directed toward support of the blood volume. Since the loss of blood and plasma is progressive and cannot be controlled, what will be the cost of delayed therapy?

The statistical studies of Bull and Squire[16] have provided an excellent background for the study of mortality. Figure 3, based on 794 burned patients, demonstrates the high mortality which occurred despite therapy. Patients with burns of 5-15% of the body area will probably survive if given fluids orally. Burns of 40% or more will produce a

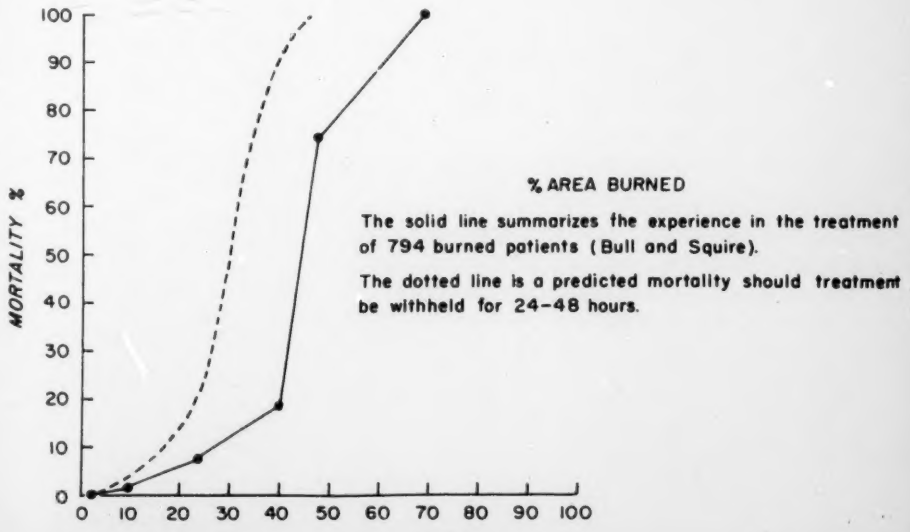

FIG. 3.

tremendous mortality regardless of prompt therapy. Burns of 20-40% will frequently produce a severe depletion of blood volume, shock, and death unless given early treatment. Most of these patients will survive if given prompt treatment. Many of them will die if not treated.

Bailey[19] states that shock is responsible for 80% of the deaths from burns. Thus if the depletion in blood volume is not corrected early, the mortality curve may shift as suggested in Figure 3. If we assume that 17,500 casualties have complicated or uncomplicated burns and that the percentage of body area burned among the hospitalized patients is distributed as follows:

	Casualties
5-20% of body area	50%
20-30% of body area	25%
30-40% of body area	15%
Over 40% of body area	10%

we may estimate that delayed treatment will increase the mortality by 15-20%, or an additional 2,625-3,500 casualties.

Ziffren[15] found the average period of hospitalization for burned patients to be approximately 90 days. This should not be greatly prolonged by a delay in initial therapy.

The professional requirements for the initial care of the 10,500 burned patients might be estimated as follows:

Many of the casualties would not require anesthesia and operation. A team of one general surgeon B 3150, four general surgeons C 3150, and one anesthesiologist 3115, could manage a maximum of 75 patients daily.

The care of 10,150 uncomplicated burned patients within 24 hours would require 136.7 teams; within 48 hours 68.4 teams (Table XXX).

TABLE XXX. PERSONNEL REQUIREMENTS FOR CARE OF BURNED CASUALTIES

		Care Within 24 Hours	Care Within 48 Hours
General surgeons	B 3150	137	68
General surgeons	C 3150	547	273
Anesthesiologists	3115	137	68
Total		821	409

SUMMARY

In summary, to add our estimated figures of mortality, morbidity, and cost would be to compound our errors. A few facts and many assumptions have been offered for your critical analysis as all the facts and opinions are collected. Such a report is a stepping stone to rational planning rather than a point of reference.

This much we believe: the early increase in mortality with delay in therapy will be due primarily to delays in correction of blood volume deficits and mechanical defects; increased morbidity will be due primarily to increased infection, increased destruction of tissue, and delays in secondary wound closure.

In order to give precedence to "life over limb" and to provide the greatest care for the greatest number, priority of supplies and professional attention must be given to the control of external hemorrhage, correction of blood volume deficits, treatment of burns of 15-40%, amputation of mangled extremities, "non-operative" treatment of penetrating chest wounds, and when possible, repair of penetrating abdominal wounds.

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Military Medical Aspects of Antibiotics and Biologicals for Mass Casualties*

By

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INTRODUCTION

DURING the initial few hours of an atomic-thermonuclear war, the enemy would have as his first objective the destruction of our power to retaliate with similar weapons upon his own country. His next objective would be that of obtaining air supremacy. The third objective would be the destruction of industrial potential to rebuild air power, including guided missiles. During this initial phase of the war, the use of atomic and thermonuclear weapons would have its greatest indications and also the greatest potential for mass casualties. Thereafter the nation possessing air supremacy could proceed systematically with limited objectives and accordingly smaller casualty results.

Within the Zone of the Interior atomic and thermonuclear weapons may be expected to produce a breakdown of protective measures affecting public health, such as water, sewage disposal, electricity, refrigeration, heating, and surface transportation. Intimately connected with the problem of maintaining public health would be the difficulties of controlling fire, maintaining communication, and providing police protection. To varying degrees the destruction of a way of life would affect the military as well as civilian population within the Zone of the Interior and again in overseas areas.

The military medical approach to mass casualties produced by atomic and thermonuclear weapons must stress the following:

(1) Emergency public health measures necessary to tide over citizens until relatively normal conditions are restored.

(2) An estimate of the potentialities of the weapon employed whether it be conventional bombs, mortar shells, high explosive shells, napalm bombs, or the unconventional weapon of atomic warfare (blast, radiation, and fire injuries), biological warfare, or chemical warfare.

(3) Triage.

(4) Mobilization of supply depots.

(5) Medical channels of evacuation; first aid stations, evacuation hospitals, hospitals of final definitive care.

(6) Availability of surgical consultants and research teams for teaching, continuity of knowledge, and evaluation of best methods of management for mass casualties.[1,2]

The above items are essential to the treatment of mass casualties in general and affect the indications and usefulness of antibiotics and biologicals that may be used. It is anticipated, unlike the experience in Korea, that in atomic warfare infections may be greatly increased due to delays in evacuation, limited number of trained medical personnel, and inadequate supplies and masterials. As Dr. Altemeier and Col. Pulaski predict,[1] there would be necessary a long time lag of 24 to 72 hours or more between injury and treatment. There would be a heavy clostridial contamination of wounds of all types in mass numbers. The helicopter and airplane demonstrated their usefulness in Korea in promoting rapid evacuation.[1,3] Under the conditions of mass casualties, these methods of transportation would speed the distribution of medical personnel, medical supplies, and material. The system of air evacuation presently employed within the

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continental United States could readily be extended to evacuation of patients to hospitals of definitive care. The success of aerial transportation of patients is well documented in the history of World War II and the Korean campaign.

Antibiotics

Despite the excellent record of the Korean campaign, "infection continues to be an important complication of war wounds. Antibiotic therapy has not eliminated this complication, contrary to widespread belief of medical officers, particularly in the forward areas."[1]

The most useful antibiotics at the present time may be considered to be penicillin, aureomycin, terramycin, streptomycin, chloramphenicol (chloromycetin), erythromycin, and other tetracycline drugs. By far the most useful at the present time would seem to be penicillin which can be made available in syrettes for the use of anyone able to inject a needle. Long-acting forms of penicillin are available but have certain disadvantages, chiefly that a patient in shock will not absorb significant blood levels of the penicillin.[1] This disadvantage can be offset by the use of intravenous aqueous penicillin G. Another objection to long action antibiotics is that they permit the development of resistant strains and prevent the employment of appropriate rest periods during therapy.[1,5] This would be a source of increased morbidity. The experience in the Korean campaign as attested by Col. Lindberg[1] reveals the necessity of recognizing antibiotic-resistant strains, which may call for a revision of therapy. On the other hand the use of long-acting antibiotics may be desirable in the ambulatory type of patient who is being evacuated without medical supervision.

Other antibiotics may be made available and be useful, but care should be taken to know the pharmaceutical features of each agent. For example, the tetracycline drugs are very similar from a chemical standpoint but if failure occurs in therapy the physician should shift to another drug rather than to another tetracycline drug.[4]

Less useful agents include bacitracin, neomycin, and polymyxin.[6] However, they should be considered for topical application in the treatment of abscesses and in refractory infections.

Under certain circumstances such as mass casualties occurring in tropical areas overseas the use of chloroquine-primaquine for malaria may be indicated, as well as the amebicidal drugs.

The indications for antibiotics in mass casualties are divided between those of prophylaxis and treatment of infection. Prophylaxis commonly adopted during the Korean Campaign consisted of procaine penicillin 600,000 units, and streptomycin 0.5 gm intramuscularly twice daily for 5 days. Where shock was present the use of aqueous penicillin G intravenously was advocated. In burn therapy the use of penicillin, streptomycin, and antitetanus prophylaxis is desirable.[1,7,8,17] A high percentage of infection in penetrating wounds of the abdomen and chest and burns during conditions of the Korean Campaign, World War II and even in small-scale civilian disasters,[1,2,8] reveals that the use of antibiotics is not as effective as often stated. One must not neglect the features of prompt and early debridement.[1,9] The extent of debridement necessary in burns and in the low-velocity missiles of atomic warfare is not as extensive as in high-velocity missiles of conventional warfare.[9] Other critical factors in infection include shock, malnutrition and radiation illness. Cronkite[10] does not favor starting antibiotics for 5 to 7 days after exposure to radiation unless evidence of infection such as fever or ulcers is present. He favors the use of penicillin tablets, 100,000 units every 4 hours, and aureomycin, 250 mg every 6 hours. Where specific infection develops during radiation illness, parenteral procaine penicillin and other antibiotics as indicated are employed. The most effective antibiotics available in biological warfare are covered in AFM 160-21, 15 Feb. 54.[11] It is of interest that our most skilled surgical teams in Korea lacked experience and training in the diag-

nosis of peritonitis and gas gangrene infections. Careful examination of patients with penetrating thoraco-abdominal wounds at the evacuation hospital level in Korea proved to Altemeier and Pulaski that infection is still an important complication in these injuries.[1] Peritonitis was said to be infrequent by the staff, and yet all but two of 31 patients examined showed residual evidence of infection, including subphrenic abscesses, serious wound infections with dehiscence, retroperitoneal or perivesical cellulitis, fever, and leukocytosis. "Intractable paralytic ileus" was undoubtedly due in two cases to active infection. The investigators recommended that all medical officers become familiar with the masked or obscure signs and symptoms of postoperative peritonitis.

Certain contra-indications to the use of antibiotics deserve emphasis; trauma without break in skin and uncomplicated fractures are not indications for antibiotics. As suggested by Cronkite, antibiotics should be deferred for a minimum of 5 to 7 days following exposure to ionizing radiation. There are some who believe that antibiotics should be reserved for specific indications of infection, even in radiation sickness. A further contra-indication to use of antibiotics is that of triage; for example, overwhelming blast injuries, burns in excess of 45% to 50% and individuals who have probable fatal exposure to ionizing radiation.[7,2,12] A history of previous severe penicillin sensitivity would favor the use of an alternative antibiotic if available.[16] Where resistant strains develop in the presence of an antibiotic continued for more than 5 days, the antibiotic should be discontinued in favor of some other agent, at least temporarily. Sensitivity plates may help narrow down the type of antibiotic but clinical trial and error may be necessary[6] under such conditions. It is not expected that this would present a problem, however, except in the hospital of definitive care.

Routes of administration. For the ambulatory type patient it would appear desirable to make use of long-acting depot penicillin or of oral antibiotics. In the presence of vomiting, such as with severe burns or with abdominal injuries, oral medications would be impracticable. In the presence of shock the intravenous route is preferred. The possibility of penicillin syrettes as part of a first aid kit for distribution to the general population during periods of alert should be considered. In general, the use of parenteral antibiotics insures the utilization of the antibiotic by the patient, whereas the oral routes leave the treatment entirely up to the patient.

Chemotherapy should not be overlooked, the sulfa drugs having performed successfully under the disaster conditions at Pearl Harbor.[1] Sulfa-diazine and gantrisin in particular offer the advantages of oral application, relatively low toxicity, and general effectiveness. They also have indications in the treatment of bacillary dysentery that may be prevalent under the conditions of mass casualties.[13,14] Their value in radiation illness is dubious.[10]

Biologicals

Among the most useful biologicals in mass casualties may be expected to be tetanus toxoid and antitoxin. Under the conditions of disruption of public health facilities additional biologicals of use include typhoid-paratyphoid vaccine, smallpox vaccine and diphtheria toxoid. All of these agents are mandatory in the military population and desirable among the civilian population during periods of national disaster. Typhoid fever epidemics are not prevented by immunization alone, as shown well by Balim and Gronbeck[14] who describe a severe epidemic due to a break in the simple measures of personal hygiene and sanitation. Booster doses of tetanus toxoid are desirable, if not mandatory, following injuries in military personnel, since they have been previously immunized. In the civilian population without such protection the use of tetanus antitoxin is mandatory.

Under the conditions of atomic warfare with mass casualties and delayed definitive treatment, clostridial contamination would progress to infection. Even in Korea Alte-

meier[1] found that clostridial infection was more prevalent than previously believed. In part this was due to the inexperience and inability of otherwise highly skilled surgical staff men to recognize the symptoms and signs of clostridial infections. The diffuse myositis typical of gas gangrene was less prevalent than liquefaction of muscle in localized myositis by proteolytic bacteria. Under the conditions of mass casualties in atomic warfare the use of gas gangrene toxoid immunization is suggested by Altemeier as a major hope for the prevention or suppression of clostridial infections. Such a toxoid is in the process of development at the University of Cincinnati.[1] It is conceivable that research may show, under the conditions of delayed debridement and shock which occur in mass casualties, that antibiotics will be less effective than the immunization produced by properly designed gas gangrene toxoid. High fever, leucocytosis, purulent exudate, cellulitis, lymphangitis and lymphadenitis had been held to be signs of and symptoms of clostridial infections, just as they are of pyogenic infections. As Altemeier points out, this impression is erroneous since severe and fatal infections often are associated with normal or lightly elevated temperature, no purulent exudate, but profound toxemia.[1] A wound with a watery discharge and an extremely foul, sour odor; with an infection limited to the muscle bundles and spreading along the muscle areas together with profound toxemia, falling red blood count and hematocrit suggest the proteolytic type of clostridial myositis. In a hospital of definitive treatment, such as the Tokyo Army Hospital, "extensive incision and drainage and excision of necrotic tissue followed by the use of an oxidizing agent such as hydrogen peroxide or zinc peroxide combined with large doses of antibiotics gave uniformly good results with clostridial cellulitis. Theapeutic gas antitoxin appeared to be of little value."[1]

Other biologicals of usefulness in certain areas would include cholera, yellow fever, and typhus vaccines. Under conditions of outbreaks of botulism, the use of antitoxin A and B may be life saving. Under conditions of biological warfare other biologicals would be helpful.[11]

Contra-indications to biologicals would include those of sensitivity to horse serum and egg as well as those of triage as previously discussed.

Routes of administration. The subcutaneous or intramuscular route and the cutaneous route in the case of smallpox insure the protection of the individual within the limitations of the vaccine. Combined administration is of value for typhoid and paratyphoid A and B. A combination of tetanus with diphtheria toxoid is a desirable peace-time measure. This has already been done in the Armed Forces.

Comments on Supply, Distribution and Utilization

The problem of how much in the way of antibiotics and biologicals to stockpile should be correlated with population areas, the priority of the target in relation to other targets, and the ability to mobilize medical supplies from other supply depots. It is logical to establish medical supply depots in areas that are remote from the maximal sites of target destruction. Such depots should be protected from fall-out radiation and be located away from prevailing winds. During a cold-war phase such supply depots can be used for normal distribution to the public and in this way out-dating of the stocks can be avoided. Some solution to avoid the out-dating of penicillin in disposable containers remains to be found. It is not likely that the amount of penicillin to be stockpiled for national emergency would present a problem in view of the observation of Jackson and Dowling,[7] that in the United States during 1951, 324 tons of penicillin were produced. This amount of penicillin is enough to cure each person in the country of pneumococcic pneumonia. In the same year, 167 tons of streptomycin were produced, enough to treat one million persons with pulmonary tuberculosis for an entire year, or to manage all the new cases that developed during the past ten years. 250 tons of chloramphenicol,

chlortetracycline, and oxytetracycline were produced in 1951, a quantity sufficient to provide approximately 200 million patient days of treatment.

The problem of tetanus-diphtheria toxoid as well as smallpox vaccine would best be met by continued intensive propaganda directed at the use of these biologicals in infancy and in the pre-school child. By this method the mass casualty patient would present at most a problem of the booster dose.

The problem of distribution of antibiotics and biologicals during a time of mass casualties is a pressing one. In general it appears wise to advocate the distribution during period of alerts of "sulfa" tablets, penicillin cartridges and broad-spectrum antibiotics to civil defense workers, firemen, police, Red Cross and other volunteer workers, and even the individual citizen.[18] The individual citizen's emergency kit should also contain a canteen of safe water and emergency medical tags for application to the mass casualty. At the level of aid stations, evacuation hospitals, and hospitals of definitive care there should be no problem of distribution of antibiotics. Supply for such centers should be capable of rapid and immediate expansion by the use of helicopters and other aircraft from supply depots to the perimeter of the disaster area. Air transportation offers the most expeditious and prompt delivery of medical supplies under conditions of disrupted highways and other means of transportation.

Utilization of Antibiotics and Biologicals

An intensive and continuing training program of medical and paramedical personnel as well as the individual citizen in his responsibilities for mass casualty care must be carried out. Thorough indoctrination and preparedness will permit the maximum utilization of the limited numbers of medical personnel for a mass casualty rate out of all proportions to civil experience. This program can be adopted on a continuing basis by civil defense authorities, fire, police, Red Cross, civil service organizations, labor unions, United States Public Health Service, and the military. Medical societies, hospitals and medical schools have a responsibility to know their part in the overall program. That this is thoroughly understood by some leaders is evident from a perusal of "The Physician in Atomic Defense" by T. P. Sears of the University of Colorado.[15]

Summary

This brief presentation, I trust, has served to illuminate the difficulties to be encountered in the handling of mass casualties with antibiotics and biologicals. The phasing of timing, training and distribution offer the key to the problem. This is a formidable, if not nearly insurmountable one, for an America which has never known the destructive bombardment of enemy aircraft. Military journals and governmental agencies must take leadership and initiative in making the public realize its responsibilities for the minimizing of mortality and morbidity in the event of atomic or thermonuclear warfare.

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Blood and Plasma Volume Expanders in the Treatment of Mass Casualties*

By

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IT IS mandatory that we maintain maximum preparedness and flexibility in planning if we are to save the greatest number of casualties in a major disaster. We may not have advance knowledge of causative agents to be used in the disaster, the climatic conditions under which it will occur, or the probable number of casualties to be encountered.

Twenty severely injured patients will temporarily disrupt the well staffed and well equipped hospital. Some years ago the Coconut Grove disaster in Boston disrupted the hospital system for days. The Pearl Harbor disaster necessitated many compromises and makeshift arrangements in caring for casualties. If we magnify this disaster a hundred or a thousandfold with a number of disaster areas over the nation, we can readily understand that even though personnel, equipment and supplies are plentiful and strategically located, the initial impact will cause sufficient delay that many casualties will show severe shock when first seen.

Blood and the plasma volume expanders will be at a premium; therefore, the proper triage of casualties is of great importance in order that only those who may be benefited will receive these precious commodities. In treating mass casualties we would like to have ample amounts of colloids fulfilling the criteria for an ideal plasma expander.[1]

HUMAN SERUM ALBUMIN

At present human serum albumin is the only blood derivative that is a plasma volume expander meeting all required specifications. It is prepared from human plasma by fractionation and then heated for at least ten hours at 60°C, thus inactivating the infectious agents of viral jaundice.

In my estimation the small standard package (25 gm. of albumin in 100 ml. of diluent) is the most flexible and effective unit for the correction of hypovolemia. It can be used as a 25% solution if desired, or it may be diluted with a crystalloid solution and administered effectively as a 3% or 5% solution. The armed services' specifications for commercially prepared intravenous solutions call for a sufficient amount of vacuum to pull 100 ml. of albumin into a 500 ml. bottle of solution by using a double ended needle; thus a 5% solution of albumin can be prepared in about thirty seconds. If preferred, the small intravenous set in the serum albumin package may be connected with the intravenous tubing used for administering the crystalloid solution and thus any desired dosage may be administered. Serum albumin may also be given in this same manner with whole blood if a very rapid oncotic effect is desired. My only objection to a 500 ml. package of 5% serum albumin is that some of the flexibility in administration is lost and there is greater breakage when stored at temperatures well below freezing.[2]

Although serum albumin is perhaps superior to plasma as a colloid for the treatment of hypovolemia, there will not be enough available due to the excessive cost and the difficulty in obtaining sufficient blood to produce the required amount of albumin.[3]

PLASMA

Properly aged liquid plasma and serum albumin are, in my opinion, of equal value in the treatment of hypovolemic shock. The value of plasma in such cases cannot be questioned; however, its use has decreased

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greatly in recent years due to the hazard of viral hepatitis following plasma infusions. This danger can be minimized or entirely avoided by storing liquid plasma three months at 37°C. and then nine months at 25° to 28°C.[4] Liquid plasma stored as just mentioned is no longer plasma in that all the labile constituents have been destroyed. The antishock properties remain and are as effective as in fresh plasma.[5] The electrophoretic patterns of aged liquid plasma tend to resemble those of serum albumin.[5,6]

Near the beginning of the Korean War much of the surplus dried plasma from World War II was reconstituted and repooled into large pools without regard for the original lot or pool numbers. The pools were permitted to be of such size that each one represented plasma from as many as 5000 donors. This material was irradiated and redryed; however, ultraviolet irradiation failed to inactivate the infectious agents of viral jaundice present in the large pools. A sufficient number of cases of viral jaundice appeared in the recipients that its use was discontinued. Much of this stockpile of plasma was then fractionated into serum albumin and used without danger of viral jaundice, mainly because the serum albumin was heated for ten hours at 60°C.

If a national disaster were to occur now, the urgency would be such that little attention could be given as to whether the expander used might produce viral jaundice, be largely excreted by the kidneys in a few hours, or in part deposited in the tissues.

Dextrans

Commercial dextran is used in the first aid treatment of hypovolemia in many hospitals where blood is not readily available. Sufficient evidence has been accumulated in Korea and the large hospitals of this country to assure us that commercial dextran is an effective plasma volume expander.

The administration of two or more liters of dextran without transfusions of whole blood cannot be recommended. Carbone, Furth and Crosby,[7] Adelson, Furth and Crosby[8] demonstrated a prolonged bleeding time with bleeding tendency in all subjects receiving large amounts of a commercial dextran. They also found that 28% of the subjects who received 1000 ml. of dextran showed the same tendency. This tendency appears to be increased in thrombocytopenic subjects. It may be well to bear this in mind when treating radiation injuries. This bleeding tendency was not noted in treating hypovolemic combat casualties in Korea.[9]

Dextran prepared according to the specifications outlined for the armed services by the National Research Council[10] if used judiciously is effective in treating hypovolemic casualties.

Gelatins

During World War I Hogan[11] advocated and used gelatin as a plasma expander in the treatment of shock in combat casualties. It was unsafe and none too effective as an expander largely because of improper preparation. Prior to World War II Hogan[12] attempted to revive the use of gelatin for the treatment of shock. He believed it might be superior to plasma for this purpose. The prospects of a possible shortage of whole blood, plasma and serum albumin during World War II created a revival of interest in the use of foreign substances as plasma volume expanders. Many such substances were proposed during this period but none were recommended by the National Research Council for use in the Armed Forces, largely because they failed to meet all of the criteria for a satisfactory plasma substitute[1] and because a very large national blood program was under way.

Ravdin,[13] Evans,[14] Frawley, Artz, Howard[9] and many others have amply demonstrated that properly prepared gelatin of the correct molecular range can be used safely and effectively in the treatment of hypovolemia resulting from burns and other trauma.

Some difficulty may be experienced in cross matching blood for transfusions following administration of gelatin, but this can be overcome by the use of glycine in the cross matching procedure.[15] The majority of

the gelatin solutions gel at room temperature (25° to 28°C.) but this is not true of the modified fluid gelatin as prepared by Tourtelotte.[16] About 75% of this type of gelatin is excreted in the urine during the first six hours after administration. The same holds true for commercial dextran. Both gelatin and dextran are capable of maintaining sufficient volume expansion until the casualties may receive blood.[9]

Oxypolygelatin is prepared by condensation of gelatin, followed by oxidation with hydrogen peroxide, and serves fairly well as a plasma expander in some instances while in others it is little better than a crystalloid solution. This is due mainly to the difficulty in preparing uniform lots of the material. The future of this product as a plasma expander is not too encouraging.

Polyvinylpyrrolidone (PVP)

Polyvinylpyrrolidone is synthesized under high pressure from a mixture of acetylene, ammonia and formaldehyde. PVP having a molecular size ranging from 40,000 to 80,000 is an effective plasma volume expander in that it corrects hypovolemia in the severely injured. It fulfills all the criteria for a plasma substitute except for the fact it is stored in the tissues. Ravdin's[17] work indicates that by varying the molecular weight of PVP a material can be prepared that is totally excreted in two to four days, but the higher molecular weight material that approximates the size of the albumin molecule (60,000) is not totally excreted. Thirty-five to fifty percent of the commercially prepared PVP is retained in the body indefinitely after intravenous administration. It is not advisable to administer large amounts of solutions intravenously which are stored for a long period or perhaps permanently in important organs of the body.[18] Until it is definitely known whether this storage is harmful it should not be used routinely as a plasma substitute. Even in dire emergencies the amount given to any one casualty should be limited to 1000 to 1500 ml.

Crystalloids

The use of crystalloid solutions will aid in the prevention of hypovolemia if given early. If given rapidly after hypovolemia develops they will in many cases be of fleeting benefit in the control of shock. Ravdin[17] states, "Crystalloids carefully chosen and wisely administered might save lives by extending the availability of plasma and the plasma expanders." In the early days of plasma preparation it was customary in many laboratories to collect 500 ml. of blood in 400 to 500 ml. of a modified Rous-Turner solution (dextrose-citrate mixture). The plasma was drawn off after the blood had sedimented and the plasma stored for later use. This dilute normal plasma was quite effective in treating hypovolemic shock, and by using it in this form the supply of plasma was extended. I mention this because in time of major disaster it may be necessary to use crystalloid solutions along with blood and the plasma volume expanders, thus extending their availability.

Stable Plasma Protein Solution (SPPS)

The late Doctor Edwin J. Cohn and his Associates at Harvard prepared a stable plasma protein solution by zinc precipitation. This yielded a preparation that was essentially a dilute albumin solution. If properly stabilized it can be heated for ten hours at 60°C. There is considerable difficulty in removing the zinc used in its preparation. Further research is required before SPPS can be accepted as a plasma volume expander for routine use.

Blood

If it were possible to have available adequate amounts of whole blood, refrigeration and transfusion sets as we have in our daily hospital routine, we would have comparatively little need for plasma, or other plasma volume expanders in time of national disaster. Unfortunately, blood is difficult to store, has a short life of twenty-one days for transfusion purposes and requires constant

refrigeration. The general use of Group O low titer blood is not without danger. If Group O is not used routinely, meticulous cross match procedures must be carried out. It has been possible to store blood in the frozen state, thaw it months later and use it for transfusion. This is a tedious and time consuming process still in the research stage.

Discussion

Severe trauma is the earliest sign of impending hypovolemic shock. The keynote in the treatment of these casualties is early and adequate treatment. Whether we can accomplish this will depend to a great degree on our state of preparedness. Kern[19] states, "Our hope of national survival rests on being prepared to meet any attack. An adequately trained reserve is the keynote of that preparedness." Medical students can and should be reservists, and this training should start in the first year of medicine and be emphasized throughout the four years, not as an additional, separate course in medical education for national defense, but as a part of almost every course in medical school. Disaster medicine is not only interesting but embraces all medical specialties. It requires good judgment, quick decisions, and demands ingenuity on the part of administrators and medical personnel.

Preparedness is the responsibility not only of the Armed Forces, but of every citizen and every organization in the country. Every facet of preparedness must be coordinated or dovetailed to properly fit into the master plan. In too many metropolitan areas only lip service is given to the disaster plans. In the Miami area twenty-seven of our larger public schools can be converted into hospitals with complete staff, equipment and supplies on short notice. Disaster practice is held to acquaint personnel with some of the problems that arise even during a simulated disaster. Many rough spots show up at times, but it is valuable training.

We should know what each state can provide to other parts of the country in time of disaster. To give one small example, the approved community blood banks of Florida can ship 7100 pints of whole blood within twenty-four hours to distant disaster areas. In addition they can ship 3500 pints of blood daily and still take care of local emergency requirements. They can ship immediately over 10,000 bottles of liquid plasma. Many blood banks are building up a stockpile of liquid plasma for disaster use. Our own blood bank maintains a plasma reserve of over 3000 units (300 cc each) that has been stored for more than one year at room temperature, and an additional 2500 units less than one year old.

Selected and approved blood banks over the nation could be of considerable assistance in time of disaster by accumulating and maintaining a large reserve of liquid plasma. Such plasma has often been referred to as "liquid dynamite." This can be true if strict aseptic technique is not practiced, but the individual who does not know or respect strict aseptic technique has no place in a blood bank any more than he has in an operating room. If liquid plasma is "liquid dynamite" then we should consider serum albumin in the same category.

Conclusions

In time of national disaster great quantities of blood and plasma volume expanders must be available within a very short time. This can only be accomplished through close cooperation of the approved blood bank organizations, the American Red Cross and other facilities in the nation. It is very satisfying to see the American National Red Cross and the American Association of Blood Banks working together to accomplish this goal.

Dextran and PVP have been stockpiled in substantial quantities, serum albumin to a lesser degree. Liquid plasma is stockpiled to a small degree at the community level. Dried fresh plasma has been relegated to the background until such time as it can be prepared without the danger of transmitting viral hepatitis. Serum albumin prepared from human plasma is presently our only

ideal plasma volume expander, but it is costly and not economical in the use of blood required for its preparation. Further coordinated research and improvements in the field of plasma expanders is urgently needed.

In time of disaster, panic, the lack of trained personnel, and the difficulty in locating many of the casualties in time to render first aid may be as great a cause of death as the lack of blood and blood volume expanders. There is no substitute for whole blood, but of even greater importance, there can be no substitute for adequate preparedness.

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Sedation, Analgesia and Anesthesia for Mass Casualties*

By
ROBERT D. DRIPPS, M.D.†

IT IS my belief that problems of sedation, analgesia and anesthesia for large numbers of casualties can be met more satisfactorily today then at any other time in our history. This is based on several factors.

1. There are more physician specialists in anesthesia than ever before, and their numbers increase annually.

2. Much of the basic knowledge needed for the safe anesthetic management of casualties has been gathered in previous wars. The principles are simple and can be readily grasped if properly presented.

3. With departments of Anesthesiology in the majority of medical schools every physician can now be given experience in the administration of anesthetics so that he need no longer be "unwilling, unable or afraid" to attempt anesthesia in emergencies. Having taught medical students for sixteen years I know that this goal can be achieved if impetus is given and if the teacher has enthusiasm for his role in national defense.

Justification for an optimistic attitude can be made by analyzing the problem of mass casualities in the following way.

1. PROBLEMS OF PERSONNEL

A. One must eliminate the need for a single anesthetist per patient whenever feasible by such means as:

(1) Having the surgeon inject local anesthetic agents whenever possible. Toxic reactions to the anesthetic drugs can be minimized by decreasing the concentration and volume of the injected solution.

(2) Use of regional nerve blocks. In World War. II with large numbers of casualties, one anesthetist would perform as many as 100 brachial plexus blocks. This provided anesthesia of 3-4 hours duration and permitted the patients to be unattended.

(3) Widespread use of endotracheal anesthesia. If general anesthesia is chosen, the induction period becomes of much importance for it is at this time that the patient's tolerance or sensitivity to narcosis can be determined. If a skilled individual administers anesthesia for induction, intubates the patient's trachea and assesses the patient's reaction to such variables as the position required for the operation and the drug administered he can turn over the maintenance of anesthesia with some sense of confidence. He can point out to his successor the degree of narcosis which seems safe. The presence of the endotracheal tube decreases likelihood of such sequelae as respiratory obstruction. The experiences of the initial contact places subsequent supervision on a more intelligent basis since at least something is known of the patient's reactions. By moving from one operating table to another one well-trained individual can advise subsequent management and can be available for consultation if the patient's condition changes. As others have stressed, this principle must be applied in other fields; i.e. the expert should be available for policy decisions and "trouble-shooting."

B. Training of paramedical personnel. Nurses trained in anesthesia will be used to the limit of their availability both for the administration of anesthesia and in supervisory capacities. Training programs must be initiated for such individuals as medical and dental students, corpsmen and Armed Forces nurses (not in anesthesia) and for such lay groups as the Emergency Aid, Red Cross and other volunteer agencies. This program should be directed by anesthesiologists and should have as its goal recognition and treat-

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ment of respiratory obstruction or inadequacy of ventilation; the treatment of low blood pressure, and the signs exhibited by patients under general anesthesia. This would provide a number of individuals with a useful orientation. Some could administer anesthesia under supervision. More would be able to assume at least limited responsibility once anesthesia has been induced by some one more skilled. It must be clearly recognized that only the citizens themselves can take steps necessary to guarantee survival in the thermonuclear age. As Val Peterson has stated, "survival techniques hinge upon the recognition of individual responsibility." The American Society of Anesthesiologists, the Association of Nurse Anesthetists, the Deans of all medical and dental schools and others in authority must believe sufficiently in the principle of survival through competency of individual citizens to provide opportunities for acquisition of such competency. At the present time it is unfortunately true that many physicians do not know how to safeguard the life of an unconscious patient. They are well versed (perhaps too much so) in knowledge of antibiotics, and opiates. They order estimations of serum electrolytes with faithful regularity, but their unconscious patient can die from soft tissue respiratory obstruction, or from the accumulation of respiratory tract secretions and the cause-effect relationship is missed altogether. This is the fault of the medical school and must be corrected. Once physicians as a group are so trained, education of as wide a segment of the population as possible is indicated.

In the postoperative period unconscious or semiconscious patients should be placed on their side to avoid respiratory tract obstruction. If the nature of the injury suggests a prolonged period of unconsciousness tracheostomy should be performed to permit easy aspiration of secretions and to minimize dangers of respiratory obstruction.

II. Supplies and Equipment

It is obvious that the more supplies and equipment available the better, but it should be pointed out that much is possible with relatively simple material. I doubt the wisdom of the suggestion that each citizen be supplied with a dog collar on which is hung morphine, an antibiotic or any other drug. But stock piling of these and other substances in protected areas, underground or away from high priority targets appears indicated. There is a need for compact gas machines which will utilize either air or oxygen. Kits containing such small but essential items as endotracheal tubes, laryngoscopes, airways, suction catheters, ampules containing morphine, atropine, a curare drug, a pressor drug, a local anesthetic, syringes and needles could be made up in large numbers to be shipped to needed localities on call or to be part of organized units. Sources of power for laryngoscope light bulbs must be developed since batteries deteriorate on standing. A huge supply of needles, tubing and solutions for parenteral administration constitutes one of the great needs for successful resuscitation of mass casualties, although oral fluids intelligently used will be of considerable value.

III. Anesthetic Management

A. Analgesia and sedation. While the casualty is awaiting operation the need for pain relief or sedation must be assessed. The undesirable sequelae of morphine (shared in varying degree by all narcotics studied to date) are well known but frequently overlooked. One can hope that with a continued educational program the indiscriminate injection of an opiate will be replaced by the more rational use of these drugs when pain is intense and relief is indicated.

An unpredictable item is that of panic and anxiety either in groups of the population or in a specific individual. This reaction might interfere with organized military or civilian efforts aimed at resuscitation and definitive treatment, as well as in military defense. It seems unlikely that such will occur. Sedatives, however, will be useful when tension and unrest rather than pain are the cause of discomfort in the wounded.

B. Preparation of the casualty prior to

induction of anesthesia. This portion of the problem involves a field broader than than assigned to me, but a few points can be made.

(1) Gastric contents. A full stomach can be anticipated in many patients. Gastric emptying is slowed during stress and inhalation of stomach contents may be a hazard during induction of general anesthesia. It is impractical to attempt to wash out prior to operation. Attempts to induce vomiting may be justified prior to induction. Fortunately not all patients with full stomachs given general anesthesia will vomit. A further safeguard is that if surgical treatment is delayed for 24 hours or more the problem will be lessened, although not eliminated.

(2) Patient's reserve. Anesthesia and operation will result in many deaths unless an estimate of circulatory adequacy can be made and borderline cases assigned to the most skilled personnel. Although head-up tilt is of some use, we do not yet have an accurate means of estimating a patient's reserve. This deserves study from the adrenal-pituitary as well as the circulatory standpoint.

C. Preoperative medication. Preoperative medication if needed can be given intravenously by the anesthetist. Atropine is not even essential in severely wounded patients. The seriously wounded will be harmed by opiates more often than not. The less ill might be managed more smoothly if pentobarbital or secobarbital were injected prior to induction, but this cannot be regarded as essential. The basic policy must continue to re-emphasize the administration of opiates only for specific indications.

D. Choice of Anesthesia. (1) For "First Aid" surgery. This presumably will involve such procedures as ligation of major vessels, amputation of mangled extremities, aspiration and closure of penetrating wounds of the chest, debridement of burns and possibly efforts to treat penetrating abdominal wounds. Some of these procedures are straightforward and the pain relief is all that will be asked of anesthesia. There may be nothing at all available—a revision to mankind's lot a century ago. There may be only the analgesia from injected or ingested non-anesthetic drugs. Or complete anesthesia may be possible. If patients with severe burns of the respiratory tract must be operated upon this will present the most challenge to an anesthetist. The next most critical category of those listed is the anesthetic management for intra-abdominal procedures where relaxation is frequently essential.

(2) More delayed and more definitive operations.

(a) Intra-abdominal. Rapid induction of anesthesia and intubation of the trachea with a cuffed tube appears indicated despite certain theoretic objections primarily related to circulatory depression. This can best be accomplished with thiopental and the new, rapidly acting muscle relaxant, succinyldicholine administered intravenously. Maintenance of anesthesia can be with an inhalation anesthetic drug. It might be ether in those casualties in reasonably good condition, or nitrous oxide for the desperately ill. If a more potent drug is followed by marked depression of blood pressure, a less potent substance such as nitrous oxide will problably suffice. Occasionally periods of muscular relaxation could then be achieved by intermittent injection of relaxants, or by "deepening" the plane of anesthesia briefly.

(b) Intracranial operations. The majority of these patients—at least adults—can be managed with infiltration of a local anesthetic. Operations conducted with the patient prone may require tracheal intubation. Often these operations are prolonged, and it may be impossible to tie up the services of a trained anesthetist. One individual can, however, supervise a number of cases.

(c) Intra-thoracic. If the chest must be opened widely, high priority must be given to providing a single anesthetist per patient. The possibility of inflating the lungs of a group of patients from a single machine designed to provide either intermittent positive pressure or positive-negative phases might be considered.

(d) Burns. Analgesia with such inhalation agents as trichlorethylene or Fluoromar should be sufficient. Self administration by

the patient is a distinct possibility. The intravenous use of xylocaine might be useful since both analgesia and sedation should be possible.

IV. General Principles in the Anesthetic Management of the Severely Wounded

The basic concept is that of use of the least amount of drug necessary to do the job. We *do* know a good bit about the management of these patients, yet the history of military medicine and civilian disasters indicates clearly that hard won lessons have to be relearned on each occasion. Facts already established are neglected with discouraging predictability. I regard this, too, as a fault of education, for surely we *can* build on the past.

V. Research Suggestions

A. Anti-shock measures. A variety of ganglionic, or adrenergic blocking agents have been studied for their ability to minimize hemorrhagic or traumatic shock. Chlorpromazine and other substances do seem to have some value if administered prior to the insult. This is obviously impractical. There are some investigators who believe that the resuscitation of patients with wound or hemorrhage shock is more readily achieved if whole blood is combined with such drugs. Careful clinical and experimental appraisal of this is needed, for there may be circumstances in which such therapy will prove of value.

B. Hypothermia. If mass casualties occur during cold weather, and if sufficient sedation or muscle relaxants can be used to reduce shivering, it might be possible to protect patients awaiting operation by reducing their body temperature. This will probably prove impractical, but use of a lowered temperature deserves some consideration.

C. The effects of radiation on the human response to anesthesia has not been documented. Animal data suggest that this may not be important.

D. A considerable amount has been learned about the response of man to various chemical warfare agents. If surgical intervention is essential in subjects who have been exposed to such drugs, we may require guidance on the problems to be anticipated. The same can be said for germ warfare.

E. Highest priority should be given to the search for an analgesic agent which is potent, effective by mouth as well as parenterally, which will last for hours and will not depress respiration and circulation. We may never find such a drug, but with it the problems which have been assigned to me would be reduced materially.

F. The selection of the anesthetic drug of choice for the desperately wounded remains unknown. This too can be approached experimentally and research on this is a must.

Summary—Principles of Care of Mass Casualties*

By

MAJOR GENERAL I. S. RAVDIN, MC, USAR†

THE basic principle upon which all military forces have traditionally operated admits of the concept that *the primary function of the operating force is to win the engagement.* This traditional concept of warfare should not be altered by any change in the design and character of military operations, or by any alteration in the weapons which will be used to prosecute war in the future. Medical support should provide the best possible methods for the prevention and treatment of disease and injury in any type of warfare. A major aspect of this concept of support is devotion to the fact that every participant who becomes ill or is subjected to injury be treated to the fullest extent possible under the circumstances in the forward areas and whenever possible returned to duty.

The Korean Adventure extended greatly our previous practices by providing a type of definitive therapy in the forward areas. The lessons learned in Korea must be consolidated and extended in order that the medical services will not be found wanting in future military operations.

The papers presented here today have stressed the fact that those responsible for military operations in the future must in their planning accept the probability that there will be casualties in numbers previously undreamed of. We, as medical officers, must accept the necessity of dealing with them adequately in the shortest period of time; that we shall have to make decisions of vital importance for those for whom medical help may well be limited to the bare necessities of making them as comfortable as possible until they die; for those who considered judgement indicates that they may be saved by supportive therapy and adequate surgery; and those who it is believed will recover without medical help. These decisions will have to be predicated upon the existing belief that in the care of casualties in a major catastrophe, the medical resources are drastically limited. The existing civilian and military concept of unlimited medical resources must no longer be accepted, but in its place we must institute the reality that care must be provided to the largest number of casualties that may be returned to duty or to a useful place in society.

We dare not fail to keep constantly in mind that future military operations will in all likelihood be associated with the use of nuclear weapons of a diversified type. They may well cause a larger number of civilian than military casualties. The problems must be solved on a broad basic concept for under such circumstances of warfare 100 percent of our available population must perform some type of duty.

Blast and thermal injury are not new in military operations as Colonel Lifton has pointed out, but they will provide new problems in their magnitude. Ionizing radiation hazards, except in isolated instances, will present problems previously not encountered. Seeking shelter for even a comparatively short period of time is of tremendous importance. Colonel Lifton has also pointed out that as a rule "decontamination should not interfere with the performance of other necessary duties," once a few hours has passed after being in an adequate shelter. The medical service must provide "first aid of a life saving nature within a few hours following detonation."

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Colonel Steer has reminded us that it is possible for a properly trained officer to determine with a high degree of accuracy, the "maximum medical load shortly after the air burst of a nuclear weapon, provided he is acquainted with the area, has collected population data and obtains a minimal amount of information from an air observer." Such information will be of great value in more accurately pin-pointing medical load and responsibilities.

I have previously indicated the importance of adequate sorting at the time of mass casualties. This requires a high degree of competence and judgement. Colonel Hartgering further points out that such action and decisions on a large scale necessitates "a dynamic medical operation." Even if the medical personnel are adequately trained for such duty the military situation and the medical load may well effect the success which ultimately will be achieved.

Dr. Smith has wisely stressed the fact that the exigencies of the situation following attack may make it necessary "that emergency medical care may so seriously occupy all medical facilities and personnel in the immediate post-attack period that definitive care will be considerably postponed," a circumstance which would reverse concepts of care developed during World War II and the Korean Adventure. As Dr. Whitney has pointed out this realignment in our thinking and performance will become necessary because "thousands of casualties will be produced in a matter of seconds," and "the longer medical care for a seriously injured casualty is delayed the less his chance for recovery." The medical officers usefulness must, under such circumstances, be extended by utilizing non-medical personnel trained to perform a wide variety of functions traditionally performed by medical officers, or highly trained enlisted personnel. The extent to which this type of training is provided over a wide area of our citizenry is of the utmost importance. Dr. Whitney's dictate "that nothing should be done to a casualty that will decrease his capacity to care for himself" is in the main correct but will require further elaboration and definition.

Colonel Shaeffer's assumption that under circumstances of mass attack and maximal casualties every physician, regardless of his previous civilian or military preference, will become a surgeon is so very correct that it will bear repeating at every conference where the care of mass casualties is being discussed. Under no conceivable circumstance will there be a plethora of medical and surgical support. Every doctor and medical officer must become more cognizant of current broad concepts of traumatic surgery. The priorities for care must be determined by deciding into which of three simple groups the casualty may be assigned: (1) the minor injuries, (2) those in need of life-saving procedures without which they may not be expected to survive, and without which at the earliest possible moment, a variety of complications may ensue, prolonging convalescence and rehabilitation, and (3) those hopelessly injured who cannot reasonably be expected to survive. Again it must be driven home that while care can be given by many, the decisions necessary under these circumstances, will be made even with a fair degree of accuracy by only the most talented and experienced doctor or medical officer.

Colonel Shaeffer has further called attention to the necessity of the surgeon innovating and improvising because of limited assistance and supplies. The surgeon will, if he is to be maximally effective, "accept compromises and assume calculated risks," but he should become thoroughly acquainted with the methods best calculated to bring about the earliest possible resuscitation. It is highly likely that Colonel Shaeffer's statement that "the greatest good can be accomplished by devoting maximum attention to the preponderant number of wounds of the soft tissues and fractures" will be found to be correct. It is an important concept and if unanimity is achieved it should be universally accepted and constantly re-emphasized.

There can be no doubt but that casualties with serious cranial, thoracic and abdominal wounds present complicated technical and physiological problems. Because of these the

resuscitative and supportive problems they present are often detailed and time consuming, and require more or less constant expert profession service. Under the circumstance of thousands of casualties the survival of individuals must be subordinated to the survival of the nation. I agree with Colonel Shaeffer that any other plan may lead to disaster.

Commander Cronkite discussed the immediate and delayed problems of radiation injury. He has called attention to the additive effect of the two sources of radiation. The syndromes of whole body irradiation varies with the dose, but for practical purposes can be divided into (1) the neurological type, (2) gastrointestinal, and (3) the hemopoietic type. Since death in the neurological and gastrointestinal type are so nearly universally fatal it is the hemopoietic type which deserves special consideration.

The essential matter in this area is to determine, if possible, the dose of radiation received. I am not sufficiently naive to believe that during mass attack resulting in an untold number of casualties this will be possible. We will, in all likelihood, be more than satisfied if we are able to determine that the casualty has been exposed to heavy irradiation, and to further class the casualties from the standpoint of survival as: (1) improbable, (2) possible, and (3) probable. Even this classification in itself will be difficult because of the wide overlapping between the groups. So much of our present experience is based upon animal experimentation, in which conflicting factors can be carefully controlled, that we may not with any degree of accuracy be able to distinguish between the various groups until wider experience is obtained in man following an attack.

It is of major importance to remember that "radiation injury *per se* from fallout should not be a major problem if troops and civilian populations are properly educated and prepared."

Burns do account for the greatest number of casualties from atomic explosions. When large numbers of burns must be cared for in the shortest possible time the open method of therapy is the only one that can be used. Here again, as Captain Miller has pointed out, the largest number of lives will be saved by "concentrating on those with moderate burns rather than attempting extensive treatment of those with severe burns." It will be difficult to adjust ourselves to this concept; it will remove the challenge of saving life in the overwhelmingly injured casualty so often present in the young internist or surgeon; it is necessary, however, that we achieve unity regarding this concept for national survival. Sentiment must play no part in these decisions.

Colonel Glass has fascinated me regarding the "Management of Mass Psychiatric Casualties," I would feel happier about this entire problem if psychological indoctrination before an attack would better prepare our people for it. I must confess that immediately after an attack I personally envisage as does Colonel Glass, that all our psychiatrists will for a considerable time "be dispelling mystery and revealing truth in the care of physical rather than psychiatric disabilities."

Doctor Howard has vividly described "The Cost of Delayed Medical Care." These data are based upon warfare as we have lived with it in previous engagements. While this experience is invaluable, he would, I am sure, agree that newer weapons of warfare may make these data obsolete from the standpoint of survival, and the complexity of the problems we may meet. He has, however, laid the basis for sound physiological concepts when he states primary attention must be "given to the control of hemorrhage, the correction of blood volume deficits, treatment of burns of 15-40 per cent, and the amputation of mangled extremities." The experience of future engagements, will, I am sure, confirm this.

The usefulness of antibiotic therapy of preventing spreading infection must be stressed again and again. We must be as sure as we can be that the broad spectrum antibiotics will be available for administration as well as the biologicals (tetanus toxoid and antitoxin) which are considered necessary. I wish I could be reasonably sure that

they will be in face of a major attack causing widespread destruction. Colonel Coone thinks they will be and time may prove him to be correct. Under any circumstances, it should be remembered that among the earliest of materials to be sent into the area of devastation should be the broad spectrum antibiotics, and the military forces and the civilian population should have this therapy taught to them in the simplest possible manner.

Dr. Newhouser, along with Colonel Kendrick, was among the earliest to become concerned with agents required to restore a deficient blood volume in battle casualties. He has called your attention to the simple fact that under circumstances of mass casualties "blood and the plasma volume expanders will be at a premium." They should be used sparingly and then only for those who have a good chance of survival. We will need to use what we have at the moment of need. Blood is best of all, and plasma, albumin and the synthetic plasma expanders, in essentially this order. But do not forget that physiological saline is better than nothing. Use it until better agents are available. Use plasma and albumin and the synthetic expanders to extend the usefulness of O blood. Let every one realize that we will be using what we have. Circumstances will not be ideal. We must save what is available for those who will benefit most.

Dr. Dripps has given us all a good deal to think about. There will not be one anesthetist for every patient. The anesthetist must improvise and extend his efforts, under circumstances he has never lived under. He must learn again that the best thing to do is to use the least possible amount of the agent to do the job. This too should be stressed again and again in every program.

I have been very interested in this entire program. Occasionally an essayist has forgotten, or strayed from the theme of "Mass Casualties," but so too have thousands of surgeons, who in each war since World War I, have learned, and forgotten, and relearned, the lesson of the necessity of adequate wound excision, which will not be possible in most instance when mass casualties present themselves. The magnificent medical achievements of the medical services in Korea will also soon be forgotten unless they are taught and retaught to all who enter medical training and constantly reiterated thereafter. Such is the treachery of time.

No one looks forward to mass destruction of our cities and to mass contamination of our farms and rivers. But we would be living in a world of dreams and unrealities if we did not face up to the direct consequences of any future warfare. We have been successful in previous wars with overseas enemies, but we have never been invaded by our enemies. Our industrial and farm production has gone on unimpeded and has in fact been materially increased, and our research skills have been applied to victory.

We may not be so fortunate in future wars. We must learn how to do work skillfully and efficiently by improvisation, when help and supplies are limited. We must learn these things before we need to apply them. We must stretch that which we have so that it will accomplish the most good for the largest number. We have lived and prospered amidst plenty; we may have to live for a time amidst scarcity. If we learn our lessons well, before their application become necessary as a result of warfare, we will succeed. The fiber of our citizenry is not so soft that they will falter. The strength of character and the intelligence of our medical officers and our civilian medical personnel is of the finest. We need only learn the lessons recounted here today, believe them, nourish them, practice them, strengthen them.

Discussion*

By
REAR ADMIRAL RICHARD A. KERN, MC, USNR (RET.)†

LET me tell you briefly some of the impressions which I have received from this splendid program.

It has been most heartening to realize how the knowledge of the effects of nuclear weapons has progressed; indeed, it has more than kept pace with the transition from the kilo-ton to the mega-ton era, fraught with fantastic capacities for destruction and the staggering threat of fallout; and it has taken the problems of the tactical use of smaller fission weapons in its stride.

Even more reassuring are the plans to make that knowledge effective both in military and civil defense. The figures on what has been accomplished in stock-piling supplies and the program for their distribution are most encouraging.

Frankly, I was much in need of this reassurance, because the picture of preparedness viewed from the civilian side in a prime target area is a much less rosy one.

Every speaker has stressed the tremendous number of casualties to be expected, the importance of early emergency care, and the fact that such care depends primarily on self-help and first aid. Yet in this regard so very little has been accomplished with our civilian population.

Nor is that all: Secretary Berry yesterday told us of his Lecture on Trauma before the American College of Surgeons. A year ago, when Dr. Kennedy gave that lecture, he stressed that the graduates of our medical schools know less about first aid than the average boy scout. I have seen the corpse of a young woman whose lacerated lips had been carefully sutured, but who had died because the young house officer had not found in her throat the tip of the gearshift lever that strangled her. The picture hasn't changed much: of our 79 medical schools, only 10 have a full-fledged program of Medical Education for National Defense (MEND).

Yet if you read the *Washington Star* of October 2nd (1955), you would know that the 75 medical schools of the USSR seem to be doing a pretty good job. You would also know that first aid is taught to every child in Russia's schools, so that by the sixth grade the youngster has passed a good standard course in the subject.

Or if you looked into this book by an American journalist, Arthur Goodfriend, and published in New York in 1950, you would learn that since July, 1948, practically every able-bodied man and woman in every factory, farm, office, apartment house and school in Russia is enrolled in some civil defense group and at least once a month must attend classes in first aid, small arms instruction, and antiair and antichemical defense. And I dare say, none need listen to a lecture such as a physician friend of mine was asked to give in a mid-western town before a first-aid class of laymen on the "Use of Traction Splints." And in my own suburb of Philadelphia we haven't yet acquired a warning siren.

And so, what General Martin urged in his Presidential Address‡ is the more important: that this Association of Military Surgeons make common cause with the Federal Civil Defense Administration in sharing knowledge, organization and leadership with our civilian fellows. The plan to publish the proceedings of this session in a single supplement of MILITARY MEDICINE is a fine step in the right direction. The preparation of

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‡ See January 1956 issue of MILITARY MEDICINE.

educational exhibits was advised by several speakers. I hope we in Philadelphia will get one of the 26 model hospitals that Dr. Whitney spoke of yesterday. I would be still happier if the moulage method of teaching first aid which the Armed Forces Institute of Pathology has set up outside this room were made the basis of teaching our civilians as well as our medical students what to do in the emergency. Our stockpiles of materials could be supplemented to good advantage by first-aid kits in home, car, office and shop: kits modeled on exhibits prepared by us and provided by the prospective individual user for himself: he would think more of it, if he, rather than the Government, paid for it. There is no substitute for adequate preparedness: it is adequate only if it includes basic training and simple equipment of every individual in potential target areas.

ORGANIZATION FOR THE MANAGEMENT OF MASS CASUALTIES*

Introduction to the Problems

By

REAR ADMIRAL THOMAS F. COOPER (MC) U.N.S.†

THE theme for today's program is "Organization for the care of Mass Casualties."

The morning session will be devoted to discussion of the roles of the major elements comprising our health resources, while the afternoon session will be devoted more to the organization per se.

Since the beginning of time, weapons fashioned by man for waging war have progressively become more powerful, more lethal, more destructive. The lance, the sword, and the old flintlock all had their day, and imposed serious problems in their time. With the development of each new weapon there is the concomitant necessity to develop counter measures to overcome, neutralize or lessen, in so far as possible, the effects of that weapon. Success in this creates in turn the necessity for development of weapons of still greater destructive potential. Thus the cycle begins all over again.

The Atomic Age, now but thirteen years old, has posed problems which in our present state of knowledge seem almost insurmountable.

Ten years ago last August we were awe-stricken by radio and press reports of the terrible destruction and carnage wrought by the detonation of a single atomic bomb dropped on an enemy target in Japan. This bomb, infinitely greater in capacity than any weapon ever before devised by man, produced effects which staggered our imagination and taxed our power of comprehension. It seemed then that here was the invincible weapon, the ultimate weapon which, being only in the possession of a benevolent and peace-loving nation, would, we dared hope, bring long lasting peace to a torn and war-weary world.

Unfortunately, the means of production of this bomb did not long remain solely in the possession of this country. Furthermore, the application of subsequent advances in nuclear science has dwarfed our giant of ten years ago and we are accordingly confronted with even greater problems of survival. The detonation of a nuclear weapon over an unevacuated principal center of our population would create an immediate calamity of great magnitude and would produce mass casualties of every variety and degree.

The problems that would confront the medical profession in the care of such casualties have been under discussion for the past two days of this convention. We have heard discussed the types and degrees of mechanical, thermal and radiation injuries produced in nuclear warfare, estimates of casualties, protective measures to be taken, and methods of treatment to be rendered under such dire circumstances. We have heard discussed the costs of delay in treatment, the problems of supply, the role of blood and plasma expanders, the problems of anesthesia and those of management of psychiatric casualties. Indeed, the problems facing us have been well delineated.

It remains, however, to define the roles to be played by the many elements that comprise our total medical and paramedical resources. That is our purpose here this morning. How can these elements—doctors, nurses, dentists, dietitians, occupational therapists, veterinarians, medical service corps officers, trained enlisted corpsmen, social service and welfare personnel—be integrated

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into an effective organization that will bring the maximum good to the greatest number? Because of the shortage of trained personnel that will exist, the utmost economy must be exercised in their utilization.

Wise planning, careful organization and continuous training of all medical and paramedical personnel in the essentials of disaster disciplines is necessary and urgent.

As preparatory measures for disaster, Dr. Frank Berry, Assistant Secretary of Defense, Health & Medical, in his Trauma Oration before the Clinical Congress of the American College of Surgeons last week, urged the following:

1. Accumulation and storage of medical supplies for ready use.
2. Universal immunization against tetanus.
3. Universal blood typing.
4. Tattooing of his or her blood type on every individual in the country.
5. Emphasis on principles of traumatic surgery in surgical teaching.

Accomplishment of these measures would materially lighten the medical problems in disaster and thus would enhance our power to survive a nuclear war.

Rear Admiral Richard Kern spoke yesterday of the broad training in the principles of first aid employed in Russia. A sixth measure might well be added to the five afore-mentioned—namely, the mandatory institution of a comprehensive course in the principles of first aid in our educational system.

Each speaker this morning represents a different segment of our health resources and will speak to you on what he or she believes to be the role of that element in the organization for the care of mass casualties.

Public Health and Sanitation Problems in Nuclear Warfare*

By

ALBERT H. STEVENSON AND ROBERT L. SMITH, M.D.†

INTRODUCTION

RECENT developments in nuclear weapons and methods for their delivery have resulted in basic changes in civil defense philosophy. These changes in turn are reflected in the need for much closer attention to public health and sanitation problems which are anticipated in the event of emergency.

The wide effects of thermonuclear weapons—virtually total destruction of structures within a mile or more of a one megaton weapon, with expectation of death of 90% of the population in an area up to about two miles radius from the center of the burst and extensive damage and casualties for an additional four mile radius, together with the hazards of lethal radioactive fallout over thousands of square miles has necessitated a more practical policy than "duck and cover."

The means exist for an enemy to deliver nuclear weapons over a series of targets in the United States simultaneously despite our military air defenses.

The establishment of a system of warning of the approach of unknown aircraft as represented by the DEW line is steadily increasing the pre-attack warning time available to our target areas. This permits the use of "evacuation" as a civil defense measure. Thus "distance" as well as reinforced concrete, earth, sand, and mortar is used as practical protection from blast, heat, and initial radiation from nuclear weapons.

Radioactive fallout represents the settling of contaminated dirt particles from the atmosphere. When a ground burst occurs, dirt and debris are taken up by the ascending cloud. Vaporized radioactive products from the fissioning of uranium of the bomb condense on these particles as they cool. The material is then distributed by the winds of the upper atmosphere and eventually settles to the ground surface. This not only complicates the planned evacuation of target areas but also brings the potential hazard of radiation sickness and death to the suburban dweller and to the rural areas as well.

To bring the public health and sanitation problems created by these threats into focus, four civil defense situations will be considered individually: (1) sabotage, (2) evacuation and shelter, (3), overt thermonuclear attack, and (4) rehabilitation, return, and resettlement.

SABOTAGE

Concentrations of selected target populations may be vulnerable to organized covert action. The food and water supplies and selected ventilation systems are particular points which might be attractive to an enemy agent. They should be protected against the introduction of contaminants—chemical, biological, or radiological warfare agents. The potential for psychological warfare which would follow any successful disease-producing attack on an element or elements of the Nation's food supply, thereby causing people to question the safety of any and all foods, is tremendous.

The protection of our food and water supplies from clandestine attack rests primarily with management of the facility. Weak points in production and delivery should be strengthened or guarded. Control tests should be made at more frequent intervals. New screening tests should be developed and ap-

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plied. Such measures will safeguard the quality of the product by providing warning of contamination or unusual change in quality.

The covert bombing of strategic installations by enemy agents always represents a major hazard. The most effective counter measures are reliance on an informed public together with an application of practicable guarding and safety measures.

EVACUATION AND SHELTER

Pre-attack evacuation from target cities upon receipt of an "alert signal" followed by a policy of "seek shelter" when the "take cover" signal of impending attack sounds, represents the best current judgment for saving lives in the event of nuclear or thermonuclear attack.

For purposes of this discussion it is assumed that each major target area will develop appropriate operational survival plans including: transportation and traffic analysis and directional plans, pre-selection of assembly and reception areas beyond the estimated zone of light damage for the target, survey and selection of shelter areas adjacent to the evacuation routes and in reception areas, warning and communications systems.

Let us take a look at the public health and sanitation problems to be faced. Imagine, if you will, a target city of 1,000,000 people which has received pre-attack warning and has initiated a tactical evacuation according to a prearranged plan. With good fortune and closely supervised traffic control, main egress routes will permit the movement of large numbers of vehicles—the principal form of passenger transportation. However, bottlenecks may be expected at the secondary road network beyond the city limits (beyond the zone of light damage in the event of nuclear weapons attack). At this point necessarily evacuees in large numbers may be diverted to assembly areas in order to maintain traffic flow to outlying reception areas on the limited capacity secondary road network.

At such assembly areas tens of thousands of evacuees may remain for periods of several hours to a day or more. Emergency bodily waste disposal facilities must be established, emergency water supply furnished, emergency first air should be available, and consideration must be given to the need for protection from radioactive fallout, in the event that the assembly area is blanketed with a dangerous concentration of radioactive particles. Evacuation patterns may have to be amended or lateral evacuation instituted on the basis of changes in predicted wind patterns.

Let us be certain we have a somewhat realistic view of the anticipated population to be evacuated. For every 10,000 people there probably will be 350 to 500 suffering from a chronic illness which dictates special care. For example, the 40 diabetics who are on insulin must have careful supervision. The incidence of cardio-vascular accidents has increased under the tension of evacuation.

The institutionalized who have been evacuated include the hospital patients who have been discharged because their condition was such that special transportation was not needed. It also includes several thousand hospital patients whose physical or mental condition is so poor that special transportation is necessary. It is planned that these patients will be re-hospitalized in available buildings in the reception area, and provision for such re-hospitalization must be made.

Proceeding now to the reception area, public health and sanitation problems become much more acute. The quiet suburban community, population 10,000, suddenly is visited by 40,000 evacuees from target complex X. This visit may be for only a few days or it may extend over many months. What are the problems which face the mayor, the city council, and the health officer from a public health and sanitation standpoint?

Housing and Shelter

Criteria must be applied to determine how many evacuees can be housed in existing dwellings by "doubling up"; how many evacuees can be lodged in other structures, government-owned or commercially owned,

without overcrowding to the extent of creating serious public health hazards from communicable respiratory diseases or from acute psychiatric problems; and how many evacuees will have to be located in temporary encampments. Where should encampments be located? A study must be made, for both the evacuees and the resident population, of shelter for protection from hazardous amounts of radioactive fallout requiring the entire population to remain under cover for a week or more. Provision for additional protective areas needed must be made including the sanitary facilities which should be provided in such shelters.

Water Supply

The adequacy of the public water supply to serve a community five times as large as it is now serving must be determined.

For example, at least one gallon per day should be supplied to each person. Medical care units must have at least 10, preferably 25 gallons, per patient per day. Mass feeding operations will require 15 gallons or more per capita per day. Fire fighting, sanitary use, and decontamination will all make their demands on the supply.

Emergency supplemental sources of supply can be obtained from farm ponds, industrial supplies, or other new ground water or surface sources. Additional treatment may be needed. The distribution system may require strengthening or supplementation, particularly to serve large concentrations of evacuees at outlying encampments. Conservation measures may be practical means of increasing the water supply coverage. Effectiveness of the protection of the water system against introduction of contamination as a result of radioactive fallout, biological warfare agents, or chemical warfare agents, must be studied.

Waste Disposal

The capacity of the public sewerage system to handle an increased load at selected points must be checked. If individual sewage disposal systems are used, must they be expanded to prevent clogging of the soil percolation system? Would it be more practical to abandon use of flush toilets (also conserving water supply) and use emergency latrine facilities? The practicality of sewage disposal at proposed encampment sites must be explored. Additional garbage and refuse collection equipment will be needed. Where can it be obtained? Is the city incinerator adequate for the increased load or should provision be made for sanitary landfill operations?

Food Supply

How long will the available food supply of the community last? Existing and supplemental food supplies should be protected from rodents and other vermin, from contamination by radioactive fallout, and from contamination by special weapons agents. Adequate refrigerated storage space should be provided. Instructions should be developed to inform the public how individuals can improvise storage for perishable foods. The adequacy of milk supply should be determined and decision made on what measures may be required for emergency pasteurization of milk if plant capacity is inadequate.

Insect and Rodent Control

The prevalence of insect- and rodent-borne disease vectors in the area and the likelihood that they may become a problem under the more primitive living conditions to be expected with a five-fold population increase must be determined. Plans should be made for the areas to be sprayed and the frequency of spraying. Plans should be made for adoption of rigid measures for the storage of garbage and for institution of rat-baiting programs as needed.

Disinfestation and Decontamination

Disinfestation of evacuess may be a serious problem. How will it be handled? If radioactive fallout occurs, decontamination measures may have to be taken. How will these be organized and undertaken?

Camp Sanitation

Emergency sanitation standards should be applied at evacuee encampments. Provision

must be made for close attention to the sanitation aspects of mass feeding operations and to general sanitation measures at all encampments.

Communicable Disease Control

Then there is the problem of communicable disease control. Some of the factors which will influence the incidence and prevalence of respiratory diseases, food- and water-borne diseases, and diseases whose vectors are insects and rodents have been indicated above. Other factors such as weather inclemency and level of immunization in the community will also be important.

Reception area health officials must immediately begin programs of active immunization of the population against typhoid fever and smallpox. Programs of immunization of children against tetanus, diphtheria, and pertussis must be continued as in normal times and enhanced so that more children are protected. Perhaps the age limit of children receiving initial immunizations as well as booster shots should be increased.

An accurate and efficient communicable disease reporting system must be called into immediate action to provide the intelligence necessary for the fight against naturally occurring communicable diseases. Such an accurate, current reporting system is also essential in detecting the use of biological warfare agents.

Laboratory Service

The diagnostic laboratory services must be fortified. The reception area—because of the necessary overcrowding and taxing of normal sanitary facilities—is a fertile field for the microbe and facilities for its detection in water, milk, food, human secretions and excretions need amplification far greater than the ratio of evacuees to normal population indicates.

Medical Care

Medical care in the reception area can be visualized only in the following light. No one but the seriously ill or injured will receive hospital care. The existing hospitals in the reception area have discharged all patients for whom hospitalization is not a necessity, and have expanded hospital facilities to the limit. Improvised hospitals have been established in available public buildings such as schools. In all likelihood, many mothers will be giving birth to babies at places other than hospitals. Medical and nursing personnel are in short supply since demands for casualty care in the periphery of cities that were bombed have caused a marked decrease in medical and nursing personnel in the reception area. The normal incidence and prevalence of many diseases is increased.

Personnel

The availability of professional health personnel resources must be determined. The sources of supply for additional needed physicians, nurses, sanitary engineers, sanitarians, and laboratory personnel must be ascertained. The supporting staff needed should be recruited and trained in advance.

Supplies and Equipment

The total supply and equipment requirements for public health, sanitation, and medical care operations must be ascertained. Sources of available supply within the community and from stocks in adjacent areas must be determined. Arrangements must be set up for schedule and transport of shipments.

OVERT THERMONUCLEAR ATTACK

Admitting the facts—that warning time and the frailties of human nature and mechanical devices will not permit full tactical evacuation—that available shelter along egress routes is far from adequate and will not be reached by many people—what are the health problems after the thermonuclear weapon explodes?

Total destruction may be expected in the immediate vicinity of the point of burst. For a five megaton weapon, the fireball alone would measure more than three miles in diameter. Extensive destruction of surface structures and some breakage of water and

sewer lines would occur within a radius of three miles of ground zero. Some 90% of the persons caught without warning in this area could be expected to die. Further out casualties will be the primary problem. Rescue, first aid, then hospitalization in improvised units will demand urgent attention. Fire fighting will be essential.

Concomitantly, area survey for radioactive fallout contamination must be made first by aerial methods and later by ground teams where the contamination is low enough to permit their operation. This survey data together with meteorological predictions and reception area monitoring observations will furnish the information necessary to guide post-attack evacuation of the target complex, to determine when outlying areas should be warned of dangerous radioactive fallout, to plan whether lateral evacuation should be undertaken or the order to seek shelter should be given, and to decide when individuals may be instructed to leave shelters.

Water and food supplies must be checked for radioactive contamination and appropriate steps taken to protect the population served or to warn them of distributed contaminated products. At all reception areas, public health and sanitation measures previously noted must be stressed vigorously.

REHABILITATION, RETURN, AND RESETTLEMENT

Public health criteria must be applied to determine when conditions will permit the return of displaced persons to their homes or resettlement to new areas. Factors to consider are: the degree of residual radiological contamination; the need for decontamination; the availability of housing meeting emergency sanitation standards; the availability of adequate basic sanitation facilities such as safe water, sanitary waste disposal, appropriate food storage and handling facilities; adequacy of communicable disease control measures as reflected by re-established reporting procedures, immunization of children, tuberculosis and veneral disease surveys; adequacy of insect and rodent control measures; and availability of medical care facilities and services.

SUMMATION

In summation, the public health and sanitation problems posed by the threat of nuclear attack against multiple targets in the United States are staggering. Clandestine attacks against our food or water supplies are feasible and could do considerable harm, particularly if used in conjunction with psychological warfare. Overt attack with thermonuclear devices would cause widespread destruction and death in the proximity of the detonation point. An evacuation-shelter concept appears to be the most practical solution as a civil defense measure.

The reception areas swollen with evacuees from many target cities can be compared to a series of "boom" towns, established in a matter of hours, by hundreds of thousands of distraught, dishoused, urban people. Superimposed upon this situation, which in itself may be considered ideal for the outbreak of epidemic disease, is the threat of radioactive fallout covering thousands of square miles adjacent to each target complex.

The answer is pre-attack planning to the operational readiness stage if we are to meet these threats. Such preparedness will determine whether, as a Nation, we survive.

Welfare Problems in Nuclear Warfare*

By

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IT IS significant that in a discussion of "Organization for the Management of Mass Casualties" the Association of Military Surgeons of the United States should consider "Welfare Problems in Nuclear Warfare," the subject assigned to me. Inclusion of this subject stems, I believe, from the growing realization that in modern large scale warfare, the care of mass casualties is basic for survival.

During World War II we learned in Great Britain that the morale of the British people, which was a major factor in minimizing the effectiveness of the Luftwaffe attacks on that island, was due in large measure to the system of welfare services for the people which the British established, the immediate provision of emergency social welfare services, feeding programs, emergency clothing, financial aid, care of children, aid in reuniting families, services relating to evacuation, rest centers, and—later, rehousing, reemployment and a host of other so-called welfare services.

This term "welfare" is a very broad one. In the Public Welfare field we have come to accept its use in this general, and sometimes quite elastic, manner since specific, meticulous definition would fail to take into account the range of social needs in this country, as in other countries, which must be met through public or private social welfare agencies. In one sense it could be used to cover almost all of the non-medical problems which present themselves following an attack with nuclear weapons. Undoubtedly it covers a score of services which are related to the many and varied responsibilities of the Medical staff under such conditions. Looking through the topics on your agenda, I see that you have identified many of them for discussion. I shall use the term in the sense of covering problems which would normally be in the area of the interest and responsibility of Public Welfare and voluntary social agencies in this country.

For purposes of discussion, I should like to start with the emergency welfare problems with which we would be confronted in the event of an attack. In modern nuclear warfare for the first time in our experience, the casualties would include a literal horde of civilians—men, women, and children; young men and women who would have been the source of military recruitment, children, the aged, the sick, the weak and the helpless. For these thousands, perhaps millions, made homeless, welfare agencies will be responsible. Perhaps we might divide the emergency welfare problems into five major headings: (1) Evacuation and reception (2) Mass care (3) Registration and information (4) Temporary financial aid (5) Initial rehabilitation and recovery.

EVACUATION

In any civilian defense program evacuation must be the subject of planning both before and after enemy attack. Evacuation includes not only the physical movement of large masses of people *out* of an area under extraordinary conditions but the movement of that group *into* an area in which they will have safety and the means of survival. It will include those persons for whom the "Initial Aid and Rescue," discussed by Dr. Whitney at this Convention must be followed by other services in addition to medical aid, welfare services if you please. It includes that mass of people who must get out of the area attacked and it includes the people in the area into which these evacuees will be moved and the countless problems both immediate and

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long range that such a mass movement and adjustments will involve.

Mass Care

Immediately following any attack welfare services must be ready to provide the essentials of life for vast numbers of people. In a community hit by a modern explosive weapon a very large percent of the housing, if not all of it, will be destroyed and the area rendered unlivable for a period of time. A great mass of people, will be homeless, hungry, in a state of shock, many physically injured and exposed to whatever weather conditions exist. Food, shelter, clothing, medical care and all the components of mass care must be available and must be given to them without delay if they are to survive. I do not need to remind you of the non-casualty medical problems such a group will present. Babies will be born during the evacuation, people with chronic ailments will need care and all the galaxy of diseases to which any group of such a size would normally be expected to be liable will need medical aid. I shall not try at this time to discuss techniques nor the aspects of mass care nor its many problems.

Emergency feeding will be a first and vital need and may have to provide food for thousands, even millions of persons, depending on the nature and extent of the attack. Emergency housing is an area of essential service that carries its own universe of problems. Clothing needed under such conditions has its own, as yet, unanswered questions. All of these involve preliminary study, planning, organization and training, development of methods of distribution, questions of stock piling and a multitude of administrative problems. But we cannot forget that on our solution of these problems and on our provisions of these services will depend the survival of many, many people.

Registration and Information

Work with displaced persons both during combat operations in World War II and since the war has made us realize the importance of registration and available information for any group of persons who are temporarily—or permanently—displaced from their usual environs. Setting up at the earliest possible moment registration and information centers to help locate persons, to reunite families, to restore lost children to their parents and to compile a record of persons and of families—such a service is vital and must be available. Registration must include assembling data on those evacuated, those hospitalized, missing or killed, on separated families, on persons in need of material assistance and other essential information. Information must be available to all, not only concerning their families and friends but on community facilities, plans for evacuees, transportation and needed services. Later on, these centers will answer questions on rehabilitation, reconstruction and employment. The morale component in being able to "find out" is not a small item.

Temporary Financial Aid

The point at which mass care, feeding stations, mass housing or billeting and so forth will move into emergency financial assistance so that an individual or family may begin to plan for themselves will depend on the extent of the damage and the reestablishment of an economy in which this is possible. Under the attack assumptions given us for such purposes as Operation Alert, we know that the source of income for many persons would be for all practical purposes destroyed. Ordinary jobs as people knew them will be nonexistent. Income from private investments, private insurance, social insurance, public assistance, government employment or any other source will be disrupted. A whole income maintenance system will need to be developed and to be ready so that income either in cash or in kind will be available when it is needed.

Temporary emergency financial assistance will need to be followed by a long range plan for income maintenance and plans should include resolution of such problems as what will be done to reestablish those programs for which the government has responsibility,

such as the old age and survivors insurance system and other programs of a related character.

During this period, you are undoubtedly as conscious as we are of the need for a program of service to the dependents of the men and women in the armed forces. Other programs which were the responsibility of the Social Security Administration during World War II and for which planning is necessary include services for internees, care of repatriates, and services to people in war impacted defense industrial communities.

Rehabilitation and Recovery

Any attack will bring in its wake a multitude of personal rehabilitation problems. The obvious one that comes first to mind is, of course, the problems of those who suffered injuries and need both medical and welfare services to be restored to self-sufficiency. Rehabilitation will include development of programs for special groups of people who will be needed to fill the manpower needs for defense and for recovery. I refer to the handicapped, the aged, those in institutions and a score of situations that will come to your minds. In a period during which this country fights for its life, no pair of hands will be unimportant. Allied to rehabilitation is the concept of recovery, of reconstruction, of restoration of our way of life and in this period as well as the period of active warfare, a problem of major importance will be reemployment of persons whose former regular employment opportunities have been eliminated by enemy action. In the back to essential, although frequently different work, our experience in welfare agencies in working with employment problems during the depression days and continuously since then on special employment problems will stand us in good stead in such a situation.

Of all the elements of recovery, perhaps the most fundamental one belonging to the field of welfare is the reuniting and reestablishing of families and rendering to them those services which will preserve and strengthen family life upon which all reconstruction ultimately rests.

You may ask how will these services be made available in the United States with our vast territorial spread from great cities to the sparsely settled hinterland. Fortunately we have developed in this country a nationwide system of public welfare agencies reaching into every state and territory and in the States into every city and into the most remote rural county. There is also a system of voluntary social agencies which supplements the public program. The experience in the '30's with mass unemployment and economic disaster to families speeded the development of this system of State-Federal Public Welfare agencies, of a similar system of State-Federal Employment Service offices and of our Federal-Social insurrance system with its 538 local offices scattered from one end of the states and territories to the other. This is the organizational structure through which the program of emergency welfare service is being planned and this is the Federal-State-Local leadership by whom the planning, organization and training must be done.

You, who are familiar with the structure of the United States Public Health Service and its State-Federal-Local organization and its defense planning, will realize that we can not fail to appreciate that even this organization would be only a nucleus of the social machinery that would be needed in the event of catastrophe such as you are discussing. The problem of recruiting and training volunteers as a matter of advance planning presents many additional problems with which we are now concerned and which we must find a way to solve.

In welfare care, as in medical care, we are conscious that a massive attack by nuclear weapons on the United States would mean that much either medical or social care would have to be self-care in so far as is humanly possible and for this the responsibility in planning, in training and in leadership is a heavy one.

We know that welfare services in a post-attack period must play an important role in absorbing shock and helping people to get back on their feet and to fight for survival.

Through the miracles of modern surgery and modern medicine, you will rescue and restore the physical bodies of millions of people and return them to communities which they must rebuild. Somewhat like the nurse who cares for and steadies the patient while he learns to stand in order to walk again, welfare staff will stand ready with those services which will enable men and women to find their personal balance and to take up their economic and social life as contributing members of a nation in which every life will count.

Organization and the Management of Mass Casualties—The Role of Nurses*

By
CECILIA H. HAUGE, R.N.†

THE role of the nurse in Natural or National disaster is a vital civil defense service. Nurses must be technically and professionally prepared, organized and ready to function whenever and wherever needed.

Through the coordinated efforts in joint planning of the National Nursing Organizations, Public Health Services, Federal Civil Defense Administration and the American National Red Cross planning for nursing in emergency service has been directed towards avoiding duplication of effort and dual organization in moblizing nursing resources.

The nursing resources of our country are immense. There are approximately 390,000 active, and 220,000 inactive professional nurses; approximately 400,000 practical nurses and vast numbers of trained auxiliary workers. An additional resource is the large pool of individuals in numerous communities throughout the country who have completed courses of instruction given by the American National Red Cross. The year 1954-1955 numbers 140,000 prepared in home nursing care of the sick—over 57,000 prepared in mother and baby care, and a monthly average of 6,800 devoted Red Cross Volunteer Nurses Aides, serving in civilian and federal health agencies. This large group must be expanded to include the inactive and retired nurses, as well as increased numbers of practical nurses—all must be mobilized and organized for total community action.

Current policies governing the mobilization and distribution of nurses are based upon assumptions agreed upon by the profession:

1. That we have a responsibility to insure quality nursing in national defense.
2. That nursing personnel should be assigned according to functional category and field of nursing—promoting effective utilization of available man power.
3. That defense needs come first.
4. In the event of a full scale war, it will be impossible to maintain a reasonably adequate distribution of nurses throughout the country. (Nursing Service for civilians may be as critically essential as nursing service for armed forces.) It is obvious why the nursing profession is promoting full cooperation with civilian and military groups.

Organized nursing has already made commendable efforts to gear the profession to the nation's long range defense program. These efforts include:

(1) The American Nurses' Associations recommendation that eligible nurses be encouraged to serve a minimum of two years in military service. (Nurses who have had military experience as well as those who have had Red Cross disaster nursing experience are better qualified to meet community or national disaster situations.)

(2) The preparation of a Guide by the National League for Nursing for use in basic professional and practical nurse programs—a plan to integrate concepts of defense and disaster nursing in basic educational programs. Pilot studies are being conducted by a large number of schools of nursing on this subject.

(3) As of June 30, 1954, 100,000 active nurses had taken a course in "Nursing Aspects of Atomic Warfare" under the sponsorship of local and state organizations. This represents approximately 25 percent of active professional nurses in the United States. These courses are still being given in some

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of the states and are being broadened to include nursing aspects of biological and chemical warfare.

(4) A method of tabulating the number, location and other pertinent information concerning the nurse supply has been developed by the research and statistics unit of the American Nurses Association. This information will be useful to all local and state groups responsible for planning mobilization.

Nurses as members of planning groups are helping to organize the community health and welfare services for disaster preparedness; and the nursing organizations are integrating these plans with medical groups, health departments, civil defense authorities, and the Red Cross disaster planning groups at local, state and national levels.

Basic to effective organization of health services is a determination of the specific activities which could be assumed by each category of medical personnel. This determination must be arrived at through joint decision of medical and allied disciplines and we must work to develop training plans that can be carried out without delay. Participation of nurses at all levels of planning is imperative, if we are to move forward with our particular program for preparedness. The physician and nurse working together will decide what constitutes vital care and which disciplines will be responsible for giving this care. (It is understood that the professional nurse will organize the skilled auxiliary workers and delegate their responsibilities under the direct or indirect guidance of the physician; she will be responsible for team supervision of the auxiliary workers.)

Such a plan obligates nurses to launch extensive and intensive training programs for all categories of nursing personnel. The major problem will be:

1. To train great numbers of personnel.

2. To maintain a high level of interest on a long term basis.

3. To provide sustained practice activities based on current trends which will also include experience in Management of large nursing units and supervision of auxiliary and volunteer workers.

4. To plan for continuous coordination on a local, state and national level.

One of the most important aspects of this training program revolves around a central theme of "up-graded" responsibilities for professional nurses and auxiliary workers, who will serve as members of medical care teams, who may be responsible for:

(1) Sorting and classifying patients.
(2) Treating burns, shock; hemmorhage and respiratory emergencies.
(3) Intravenous and transfusion therapy.
(4) Obstetrical procedures, including deliveries.
(5) Administering anesthesia and life saving resuscitation measures far beyond the normal scope of nursing.

The nurse may find herself without a physician and may need to assume temporarily the physician's role on the team—which again points out the need for nurse participation and planning at all levels.

The need for training and practice is obvious. We are in a position to proceed immediately to effect on the job training whereby each group learns from the other. Nursing has capitalized on this technique and it offers an excellent opportunity for incidental learning and teaching.

To extend refresher courses for inactive and retired nurses:

(1) Courses that stress first aid measures for nuclear disaster, biological or chemical warfare victims.
(2) Methods of improvising equipment.
(3) Use of drugs and antibiotics in treatment of casualties.
(4) Intravenous therapy.

At all times nurses must be aware of state laws regulating the practice of professional skills. Long range plans would include refresher instruction and experience in specialty areas such as operating room, obstetrics and out-patient services and anesthesia.

Any discussion of plans for the management of mass casualties from the nursing

standpoint would be incomplete without means of distribution and utilization of trained workers.

Much ingenuity and cooperative planning is needed for the practical application of this entire project, for, no treatment facility will be medically sufficient—and only the essential nursing services will be provided during a post disaster period. Professional nurses will be used only for highly skilled nursing care and to direct the activities of nonprofessional workers. There will be an immediate need for a system of ready identification and redistribution of essential personnel within the field of nursing; personnel who would be required to move freely and quickly in a disaster area. The withdrawl of nurses from the civilian supply should be carried on according to a well developed plan. Because the number of trained nurses may never be adequate to care for a massive number of casualties, nursing care will be dependent on the resourcefulness of the individuals trained to give simplified care under adverse circumstances and to direct activities of others.

In conclusion, may I reemphasize that joint planning, adequate training and sustained practice are key notes to effective organization, for meeting the burden which will be placed upon us in the wake of disaster. Wise and economic utilization of nursing personnel is a responsibility we cannot delegate nor ignore. In each instance we must be aware of plans made by the local, state and federal civil defense authorities, and the American Red Cross, since these organizations have an obligation under the law to prepare communities for mobilization of resources in time of disaster. All nurses of our nation should accept the privilege and responsibility for their part in this pattern of preparedness for that catastrophe which we sincerely hope will never happen.

The Role of Medical Service Corps Officers in the Management of Mass Casualties*

By

COMMANDER KENNETH L. KNIGHT, MSC, USN†

IN GENERAL, the management of mass casualties will not require duties of Medical Service Corps Officers which are not already included in their basic mission. Due, however, to the development of new and unconventional weapons of war, additional disciplines and expanded methods of operation will be required of them. This account attempts to describe some of the projected responsibilities, traditional and new, of the Medical Service Corps Officer in the management of mass casualties.

BASIC MISSION OF THE MEDICAL SERVICE CORPS

The basic mission of the Medical Service Corps Officer is to free the Medical Officer, insofar as is practical and possible, for the care of the sick and injured. This is accomplished by assuming the management of nonprofessional medical department adminstration, logistics, and planning; and by the practice of professional skills or specialties allied to medicine. Due to the relative shortage of medical officers, this basic mission has assumed new importance in the present period. In the management of mass casualties during a disaster episode, the effect of this shortage would be even more pronounced, and the proper utilization of all presonnel trained in skills related to the practice of medicine would become even more crucial.

SPECIFIC RESPONSIBILITIES

Although military planning for the management of mass casualties varies in actual details from one service to the next, in broad outlines it is generally similar. Basically, it provides first a planning program for the predisaster period and second a tactical program for the disaster episode itself. Naturally, the second program is largely a fruition of the first. To visualize the projected role of the Medical Service Corps Officer in the management of mass casualties, it is necessary to examine these two programs in further detail.

Predisaster or Planning Phase. It is imperative that the medical section of each military command's disaster or passive defense plan contain a complete blueprint of an organization which in the shortest possible time can come into full being and commence the task of finding casualties, of initiating necessary first aid, of effecting casualty evacuation to an aid station and the services of a medical officer; and when necessary, of accomplishing their further removal to a hospital. A concomitant of this basic mission is the responsibility for providing for rescue personnel safety from any special hazards which may arise as an after effect of the disaster itself; such, for example, as would occur if the disaster resulted from enemy ABC warfare attack. In addition, the plan must provide for personnel training and supply stock-piling.

Normally, a Medical Officer will be responsible at each activity for the management of the medical section of the disaster plan. However, at commands where such an officer is either not available or is already overburdened with other responsibilities, it is believed that the training of the Medical Service Corps Officer is such as to permit him to adequately serve in this capacity. In any case, the Medical Service Corps Officer is admirably qualified to assist the Medical Officer in the accomplishment of the train-

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ing and logistic phases of the medical section of the local disaster plan.

Disaster or Tactical Phase. As pointed out earlier, plans for the tactical employment of military medical forces following a disaster resulting in mass casualties vary in actual details from one service to the next. To illustrate the role envisioned for the Medical Service Corps Officer once a disaster has occurred, a brief outline of one service-proposed medical passive defense plan is given here.

In this plan, predicated on an enemy ABC warfare attack, the tactical employment of the medical element is based on a division of the disaster area into three emergency recovery sections, established to correspond to the severity of destruction present. Section 1 is the area lying within the obstruction perimeter which is the line at which debris blocks access by wheeled vehicles. Section 2 is the area where damage is moderate to light and its outer perimeter is marked by the first appearance of debris. The area outside of this perimeter is considered to be section 3.

The medical element will be divided into 11 tactical teams as follows:

1. Field first aid team
2. Litter-bearer team
3. Field aid station team
4. Ambulance team
5. Medical holding team
6. Surgical team
7. Radiation sickness team
8. Improvised emergency hospital team
9. Casualty decontamination team
10. ABC health hazards team
11. Vector survey team

To allow the most expeditious handling of casualties, it is envisioned that these teams will be employed on an echelon basis. The first echelon medical service around which all medical support will function in the disaster area is the Field Aid Station which will be established in emergency recovery section 2 and as near the obstruction perimeter as possible. The Field First Aid team, Litter-bearer team, Ambulance team, and Field Aid Station team will constitute this echelon and will move into the Field Aid Station as a unit. As presently planned, the first three teams will be led by noncommissioned officers. The Field Aid Station team is responsible for establishing a Field Aid Station in the assigned area and for maintaining its operations, and will be in charge of a Medical Officer. A Medical Service Corps Officer will be attached to this team as the Medical Traffic Regulator. It will be the function of this individual to coordinate the flow of casualties into and out of the Field Aid Station as a part of the chain of medical evacuation, to sort the casualties needing immediate assistance from those who can wait, to control communications, and to supervise the flow of medical supplies.

As a part of the first medical echelon but physically located in emergency recovery section 3 is the Medical Holding team. The function of this team will be to establish a holding point at a railhead, air field, or other transportation pick-up point for the purpose of providing medical aid and other comforts to casualties forced to await transportation. From the standpoint of conserving medical personnel, Medical Holding teams will not be utilized unless absolutely necessary. Normally they will be required only if transportation bottlenecks are encountered in casualty evacuation. At other times the personnel of these teams will be used as relief personnel at Field Aid Stations. It is planned that the Medical Holding team will be in charge of a Medical Service Corps Officer.

Second echelon medical forces will be stationed in emergency recovery section 3 and will consist of the Surgical team and the Improvised Emergency Hospital team. In addition, other Ambulance and Medical Holding teams will be held in this area as auxiliary support for the first echelon service. The function of the Improvised Emergency Hospital team is to provide definitive surgical and hospitalization care for those casualties considered non-evacuable over prolonged time and extended distances. The basic composition of this team is sufficient to care for approximately 100 patients. One or more Medical Service Corps Officers will serve administratively with this team. Their

duties will be generally similar to those presently assigned to Medical Service Corps Officers in conventional military hospitals.

The third echelon medical forces will consist of specialized teams, i.e., a Radiation Sickness team, a Casualty Decontamination team, an ABC Health Hazards team, and a Vector Survey team. In addition, all fixed military medical installations are considered as belonging to this echelon.

The function of the ABC Health Hazards team is to determine whether food and water in the emergency recovery areas are contaminated by atomic, biological, or chemical agents, and in the event of an attack restricted to the use of BW agents to serve as an area-wide BW Survey team for the collection of environmental samples, as well as food and water supplies. The Vector Survey team will determine whether vectors capable of spreading disease exist in the area and where indicated pass survey data and recommendations for control measures to the Pest Control team of the Engineering Element. Both of these teams will be under the leadership of Medical Service Corps Officers.

The Radiation Sickness team will be sent where needed to advise and consult with local personnel on the treatment of radiation sickness casualties and will not normally utilize Medical Service Corps personnel. The Casualty Decontamination team will be under the control of a noncommissioned officer unless administrative requirements makes officer utilization necessary. In such case a Medical Service Corps Officer will be utilized for this task.

All of the above described duties are with medical element teams. The activities and deployment of these teams, along with the teams of other elements, will be directed from a Central Emergency Recovery Unit. It is believed that the training and experience of the Medical Service Corps Officer are such as to enable him to serve adequately in the post of ABC Control Officer on the staff of this unit. In such capacity, he will be responsible for radiobiological and chemical services, the establishment of control points, entry and stay times, the initiation of decontamination procedures, and for consultation with other unit members on contamination problems which are effecting their operations.

Summary

In summary it may be said that the training and experience of the Medical Service Corps Officer in the administration of medical department activities and in the practice of skills auxiliary to the practice of medicine enable him to play a valuable role in the management of mass casualties.

The Role of Dietitians, Physical and Occupational Therapists in the Management of Mass Casualties*

By
COLONEL HARRIET S. LEE, AMSC, USA†

I AM SURE I speak for all dietitians, physical and occupational therapists who have had the privilege of attending this convention, when I say that the orientation we have had to the implications of an overwhelming disaster has left us all with a sense of grave responsibility. None of us here could fail to recognize the challenge confronting our three professions to accelerate the development of realistic pre-disaster plans and training programs that will enable us to make our maximum potential contribution in the event of an emergency.

The point I should like to emphasize, if I may, in this brief paper is the immediate urgency for orientation to, and practical training in, the expanded responsibilities which will inevitably befall the members of our professions in a disaster situation. Perhaps a concrete pattern of thinking concerning this matter may best be stimulated by a review of some current concepts of the role of dietitians, physical and occupational therapists in planning for the management of mass casualties.

It is recognized, I believe, that minimum essential training in emergency medical procedures is basic to the preparation of all paramedical personnel for a disaster situation. This training should encompass the recognition and emergency care of impending shock and hemorrhage, emergency treatment of wounds and burns, artificial respiration and the application of temporary dressings, bandages and splints. Although knowledge of most of these procedures is not related to the normal professional duties of dietitians, physical and occupational therapists, it is essential to their preparation as part of the medical team for a disaster situation. With this as a basic background for all three groups, specific functions related to each profession may be considered.

Although many dietitians have served in overseas theaters in time of war, it has not been front line service. Nuclear warfare would, in all likelihood, bring the "front lines" to hospital doors either overseas or in this country. Dietitians must now, therefore, be prepared to assume the responsibility of providing emergency food service in a disaster situation which will be beyond any known experience. Pre-disaster training, planning and preparation are imperative if this responsibility is to be discharged with maximum effectiveness.

The provision of emergency food service for large numbers of people is a vital part of a hospital disaster plan. The Food Service Division should be represented on the hospital committee developing such a plan and should, in addition, have an intra-Division planning committee consisting of the professional staff of dietitians, other key supervisory personnel and representatives of a volunteer group.

The feeding of vastly increased numbers of people will obviously require additional personnel. Prior collaboration between local military and civilian units will be necessary for establishing control of hospital food service personnel as well as for advance recruiting of volunteer auxiliary personnel.

Pre-disaster plans should be developed with the proper authorities for effective measures of food and water control and security—a very major issue in a disaster situation. Planning must be accomplished for

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ways and means of providing emergency food service in such eventualities as disruption of communication and supply lines; failure of utilities; contamination of food and water by radiologic, biologic and chemical agents or by disruption of water and sewage systems.

Prior coordination will be required between the Food Service Division and the Supply Division concerning the procurement of equipment during a disaster. Pre-disaster planning for food supplies should be coordinated at the Federal, regional and local levels with those agencies responsible for overall procurement. The stocking of certain staples within authorized overages should be systematically maintained.

Since maximum simplification will necessarily be the keynote in food production and food service in a disaster situation, preliminary planning should be based on the fundamental principles of mass feeding procedures. Such procedures include the centralization of food preparation; allocation of specific areas for feeding various categories of patients and personnel; staggering of feeding schedules; simple and practical means of service; one-dish- and beverage-type meals. Planning should include provision for special groups such as infants, expectant mothers, critical cases, etc.

It will be imperative to inaugurate pre-disaster training programs for all food service personnel in the basic principles and procedures of emergency mass feeding, in the use of field equipment and expedients and in improvising cooking, serving and eating utensils. It is of vital importance that this personnel be oriented to emergency methods of water purification and waste disposal and to all available current information relating to the detection and prevention of food contamination.

When emergency food service planning has been organized, a test run to establish the workability of the plan is a valuable and practical adjunct to the plan.

The duties and responsibilities of physical and occupational therapists in the days immediately following a major disaster are not so clearly defined as those of dietitians. However, the potential capabilities of these two groups may be readily identified if consideration is given to their educational background, their professional experience, their existing skills and the possibility of expansion of certain of these skills. I should like to preface my remarks on the role of these two groups in the care of mass casualties by saying that in any realistic planning for an emergency where the survival of thousands of casualties will be at stake, one must proceed on the generally acknowledged premise that the normal functions of para-medical personnel will, of necessity, be upgraded. The discussion which follows is based entirely on this premise and is not to suggest that the members of these two professions aspire to such expansion of their duties under normal circumstances.

Physical and occupational therapists are constantly concerned with muscle function and innervation and with the prevention of deformity. They are conversant with the fundamental principles of casting and splinting in relation to optimum positions of function. This appears to be an ideal background for pre-disaster training in the actual application of splints and casts. Such additional training would enable physical and occupational therapists to assume considerable responsibility in a situation where no doctors were available to ensure that casts or splints were applied in a manner to assist rather than prevent eventual function.

The teaching of self care techniques, of ambulation, the use of crutches and canes and the evaluation of muscle function fall normally within the purview of physical and occupational therapists. These are skills which would be valuable in achieving maximum self-dependency and usefulness of patients in the shortest possible period of time.

Occupational therapists contribute an important service in the treatment of neuropsychiatric patients. Such experience would equip them to function effectively in the welfare unit of the hospital where disoriented persons or those with mild psychologi-

cal disorders may be housed. They could also make a valuable contribution in the pediatric wards.

Physical therapy plays a vital role in the treatment of burns and it is envisaged by those responsible for overall planning that physical therapists may be assigned major supervisory duties on burned patient wards. The tremendous numbers of burned patients that are anticipated in any nuclear disaster, make it imperative that physical therapists have continuous pre-disaster orientation to mass therapy techniques related to current concepts in the treatment of burns.

It goes without saying that pre-disaster training in emergency medical care should be extended for physical and occupational therapists beyond the minimum essential training recommended for all personnel if they are to be called upon to supplement the nursing services on the wards. To be prepared for this contingency, additional instruction should be conducted for this personnel in emergency medical care and should include such procedures as the administration of intravenous fluids, giving of hypodermics, taking of blood pressures, etc. The training should be of a practical rather than theoretical nature and might be effectively augmented by opportunities for observation in emergency, operating and recovery rooms.

Obviously, in the later stages of a disaster situation physical and occupational therapists will make their greatest contribution in the pursuit of their normal professional duties. Pre-disaster planning for, and orientation to, mass therapy techniques in all their professional procedures are indicated so that maximum care may be provided for the maximum number of patients.

I have touched very briefly on some of the current concepts of the role of dietitians, physical and occupational therapists in planning for the management of mass casualties. It seems unmistakably clear that the most important aspect of the planning for our three professions is that we "get on with the job." Prior preparation for the responsibilities that we will be expected to assume in the event of a major disaster is a concrete professional obligation and not a vague, intangible one. There is a bit of pertinent philosophy expressed in the following allegory by Dr. Joseph Sizoo which may give us food for thought and I quote: "The forces which keep us from our goals are not ponderous and stupendous; the weak things we do not count upon really defeat us. Great barriers are removed; tiny barriers hinder. Not long ago I met by chance an overland traveler who had walked on foot from the Golden Gate to New York. I was interested to learn what was the greatest difficulty he had encountered in his long journey. I suggested that perhaps he had found the mountains on the trail his greatest barrier, but he assured me that was not so. Then I suggested that perhaps the swollen streams which cut across his road presented the greatest hazard, but it was not that. After a while he said, 'What almost defeated me in my journey across the continent was the sand in my shoes!' "

Role of Enlisted and Technical Assistants*

By

MAJOR JOHN C. DELAHUNT, USAF (MSC)†

IN CONSIDERING the role of the enlisted and technical assistant in the care of mass casualties, the normal thinking is that these paramedical personnel would fit right into their regular medical unit and function in the area in which they have been trained. For example, the medical, surgical, and pharmacy technicians would all accomplish their duties within their specialty areas. The administrative enlisted personnel would go to their assigned areas and accomplish their normal duties, revised, of course, as directed by their units' disaster plan. However, this thinking is correct and applicable *only* for those individuals *outside* the areas of disruption. (Fig. 1).

The first area—we'll call it Zone A—is the lethal Zone. It is an area of desolation, complete destruction, and death. There will be no living casualties within this area. Thus, no immediate medical problem exists.

The next zone we will call Zone B. It is quite obvious that this zone could be further sub-divided into sub-zones with varying numbers and types of casualties, depending on how close each sub-area is to the lethal zone; however, for the purpose of this brief presentation, we will not sub-divide Zone B. It is in this Zone B that the huge majority of living casualties, the real medical problem, will be located.

Zone C includes all area not considered in Zones A and B. Within Zone C there will be little physical damage and only minor casualties.

It now becomes obvious that those enlisted and technical assistants in Zone C (outside area of Disruption) will be able to function as a unit and fit into their regularly assigned duties in their unit disaster plans. Those in Zone B, however, will not be able to operate normally due to the existing panic, disruption, and destruction. Few, if any, medical facilities will be operable. Attrition of medical personnel, including physicians and nurses, will further reduce the degree of formal medical care and organization available. This existing state of chaos, disruption, and disorganization precludes expecting paramedical personnel in Zone B to operate in their regularly assigned duties. Thus, the role of the medical enlisted man and technical assistant in Zone B must be approached from a "Time Phase" point of view.

Phase I—(Prestrike) is that period of time before a specific U. S. target is hit.

Phase II—is that period of time from the hour a specific U.S. target is hit until 24 hours post strike.

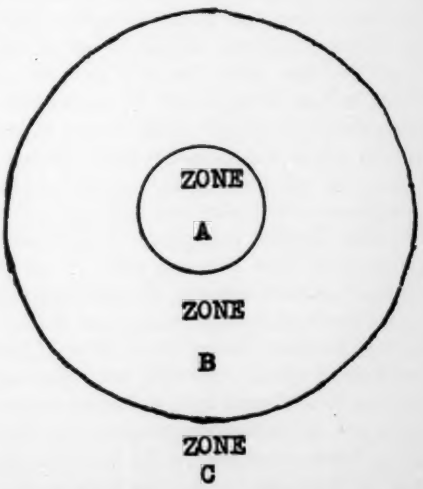

FIG. 1. Zone A—lethal area. Zone B—area of destruction, disruption and chaos. This area would contain all living casualties with major injuries and burns. Zone C—Zone of minor casualties and minor damage.

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Phase III—is that period of time from H plus 24 hours (Phase II) on until rehabilitation has become a reality.

For the purpose of this presentation, I wish, momentarily, to disregard the usual procedure of discussing time phases in a chronological manner. In order to make my point, I will discuss phase II first. It is during this phase (H to H plus 24 hours) in Zone B, that the enlisted and technical assistant can accomplish his greatest mission. If given the proper tools, which in this case is adequate pre-strike training in emergency medical care with an emphasis on improvisation, these paramedical personnel can perform a service of inestimable value at this time in the field of life-saving measures and resuscitation. Remember it is within this Zone B, with its medical supplies, personnel and facilities destroyed or damaged, that *all* major casualties will be found. The result of nuclear and thermonuclear weapons will probably prevent entry on the ground to that Zone for at least 24 hours. Helicopters or small assault type aircraft *may* be able to get into the area landing on cleared roadways or commercial landing strips but in the first few hours even that seems optimistic. Let's be realistic, let's get our heads out of the sand, let's face facts, the only medical aid found in Zone B in the first 24 hours will be improvised aid by individuals caught in the area. It is here that the buddy-buddy concept, care of the individual by the man next to him —self-care, call it what you will, comes into its own. Proper emergency medical care given in the Zone B during phase II can be the best means of reducing the mortality rate under circumstances of nuclear and thermonuclear warfare. During World War II and the Korean conflict, mortality rates after admission to a hospital have remained consistently low. It is difficult to imagine these rates going lower. It is out in the field that the marked decreases can be made in the mortality rates. *With no other* medical care available, buddy and/or self care could be the answer to a great part of this problem.

Now that we have discussed phase II—what about these same paramedical personnel in Zone B during phase III? I see them, under their remaining leaders, if they are physically able, reorganizing their units or joining units coming into the zone, supervising the preventive medicine procedures, preparing casualties for evacuation, and performing a triage function. If they are not able to continue on their medical mission they could assist and accompany the casualties being evacuated out of the Zone.

We have briefly discussed phases II and III and I have left phase I to the last because all that takes place in phases II and III depends on action taken in phase I. When is phase I? It is *now*—the present—today. Unless action is taken today, pre-strike, to insure the competency of paramedical personnel in the field of emergency medical care, the recuperability of the armed forces of the United States will be seriously hindered.

Although this presentation has been pointed at medical personnel alone, I feel that I would be sorely negligent if I omitted a brief reference to the non-medical enlisted man. In an area of disruption of the magnitude and violence we picture occurring as the result of nuclear or thermonuclear explosions, medical enlisted and technical assistants would not be able to handle the immense workload. All enlisted personnel of all services must be given an adequate understanding of emergency medical care procedures. This understanding should make them thoroughly familiar with a working practical knowledge of emergency medical treatment. They must have a knowledge of emergency medical care which is *considerably* more than that now included in standard military training. The enlisted personnel of today and the *future* must bear an increased responsibility for emergency medical care of himself and those around him. We have a grave responsibility to furnish him the tools to do this job.

Now we have been discussing a theory, a concept relative to the role of the enlisted and technical assistant in the management of mass casualties. Basically, we have said there is no problem as to what these para-

medical personnel will do if they are located outside the damage area surrounding a target area. Obviously, his unit will probably be intact and he can take his normal job as part of a highly specialized medical organization. The real key of the concept revolves around the adequacy of training of the paramedical personnel actually within the damage area during the first 24 hours post strike. *If* these individuals are competently trained pre-strike in emergency medical care they can contribute immeasurably to the recuperability of the armed services and the entire nation.

The desired degree and scope of training —the areas to be emphasized—must be decided by professional personnel and should be standard for all services. The "Great Equalizer," nuclear and thermonuclear explosion, puts everyone in the same boat and all should be equally well trained regardless of branch of service.

I submit:

(a) That increased *emphasis, now, today* be given to revise training programs throughout the services so as to insure adequate training of non-medical personnel in emergency medical care.

(b) That a carefully coordinated and progressively advanced program of instruction in emergency medical care and management of mass casualties be initiated for enlisted and technical assistants of the medical services.

(c) That both training programs described above include *special emphasis* on improvisation of potential emergency medical procedures.

(d) That some method—perhaps proficiency testing—be devised to establish and maintain the competency of personnel trained as the result of this program.

I have presented only the skeleton of this concept, no flesh, no muscles, no tendons. These necessary adjuncts to operation must be filled in by you. This concept is feasible, is operable, however, I have presented only the chassis—the skeleton. You must provide the power, the motivation, the imagination to bring such a program to life and then to its proper place in management and care of mass casualties.

Role of the Veterinary Officer in the Management of Mass Casualties*

By

LIEUTENANT COLONEL LESLIE C. MURPHY, VC, USA†

THE duties of the veterinarian in military and civil communities are well-known to this group. A brief list of duties would include the diagnosis and treatment of diseases and injuries of all animal species other than man, control of livestock diseases, public health activities, food inspection, research on diseases communicable from animals to man and veterinary education and training. Most of these skills will be in heavy demand in the post-attack period. The routine control of the spread of animal diseases will be disrupted. Animal casualties may be enormous. Homeless pets will require attention. However, until such time as the initial requirements of the medical profession are met in caring for the human population immediately after an attack producing mass casualties, the veterinarian will be called upon to give whatever assistance his individual skill will allow.

NEED FOR VETERINARIANS

This conference and others similar to it where full attention has been given to the care of mass casualties have arrived at the basic concept that the medical profession will be overtaxed with medical problems and will require the services of all groups and individuals who are qualified or trained to assist them. Many physicians will be responsible for organizing and directing the activities in caring for mass casualties and in this capacity can better serve a greater number by employing paramedical groups to assist remaining medical personnel to care for the injured.

Of the several groups who can give assistance, consideration has been given to utilizing members of the veterinary profession. Most of the literature concerning the employment of the veterinarian in the event of a national disaster deals with biological warfare affecting the animal population and the inspection of foods in the post-attack period. The importance of this phase is not minimized but must be relegated to a lower priority the first few hours or days after a mass casualty attack. In addition, the veterinary profession is presently organized and has had prior experience in eradicating or controlling animal diseases. There are many examples to show this point: The introduction of bovine pleuropneumonia and foot and mouth disease from foreign countries gave the veterinary profession an insight into methods of control. These two diseases were successfully eradicated. More recently, another animal disease, vesicular exanthema of swine, enzootic locally in California for many years, gained entrance into a Wyoming stockyard and from there eventually spread to nearly all of the 48 states. An organized eradication program of the U. S. Department of Agriculture has brought this outbreak under control.

QUALIFICATIONS OF THE VETERINARY PROFESSION

Previous experience in the care of human casualties has not been gained by veterinarians. His educational background and training, however, in the basic scientific disciplines as taught in Veterinary Colleges, prepares him to be of assistance. He is required to spend six years in the fields of surgery, physiology, anatomy, pharmacology, hygiene and preventive medicine, microbiology, clinical medicine and other sciences related to his profession. The debridement of wounds, inoculation of biologics, control of hemorrhage, use of anesthetics, intravenous use of plasma and other fluids, suturing of wounds, and other techniques are not new to the veterinarian. Some of these skills will be re-

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quired in the treatment of mass casualties.

His professional skill fits him to participate in various professional phases of the care of mass casualties. The extent of the integration of the veterinarian into this medical program, will of course, depend upon his individual skill and ability in much the same way the skills of other professions are evaluated. Methods of diagnosis and treatment of animal diseases and injuries parallel closely those of the human. Investigation which later may be of value to the human patient must, of necessity, be done on animals. This often gives the veterinarian first use of the new drugs and techniques on his animal patients.

Training

To use these skills to the best advantage the veterinarian has the responsibility to prepare himself further by attending courses of instruction in first-aid and conferences such as this to determine how he can best fit into the medical organization. Service veterinarians are currently being trained at Oak Ridge in a two-week orientation course in Veterinary Radiological Health. Military veterinary laboratory officers will soon take training at Walter Reed Army Medical Center in the Biophysics Department and Veterinary Division of the Walter Reed Army Institute of Research in radioassay of foods. In addition, the course in Care and Management of Mass Casualties at the same institution has been attended by several military veterinarians. In this latter course, the doctrine has been established that the skills of the Veterinary officer will be utilized by the Medical Corps officer since the disparity between the medical load and number of physicians will be marked. Technical Manuals published by the Federal Civil Defense Administration provide for the use of veterinarians in many capacities including duties at a first-aid station as auxiliary surgeons.

Manpower

Approximately 16,000 veterinarians in the United States and its possessions make up the manpower resources of this profession. About 3,500 students are enrolled in accredited Veterinary Medical Schools in 17 states in the United States, with a total graduating class of approximately 800 annually. Those currently on active duty in the military service of the Army and Air Force number about 800. These service veterinarians represent a cross section of their civilian colleagues as to skill and training available for use in the care of mass casualties.

Special Duties

A. *Auxiliary Surgeons.* Until such time as the physician can cope with the large number of casualties with which he may be confronted, the veterinarian may be of valuable assistance to him as an auxiliary surgeon. This is not to advocate that the veterinarian perform any type of human surgery or treatment when a physician is available. We are discussing a situation never before presented to our military or civilian populations and must take heed of the fact that all hands with any training whatsoever in medical sciences must be employed.

B. *Veterinary Duties.* After the phase of initial emergency treatment is over, the veterinarian can then enter into the fields of the control of disease, inspection of food supplies, other veterinary public health activities and the care of small animal pets and large animals found in stockyards, sale barns and farms.

Emergency Supplies

Individuals concerned with the care of mass casualties are cognizant of the fact that many veterinary hospitals, especially those concerned with the treatment of small animals, are well equipped and may be used as first-aid stations. Many of the approximately 2,300 veterinary hospitals are located on the periphery of our large cities and might be undamaged. Here would be available an emergency supply of drugs, dressings and anesthetics as well as sterilizers, surgical, x-ray and fluoroscopic equipment.

In summary, the Veterinary officer of the military services, by his training and experience along with his civilian colleagues, stands ready to assist the medical profession in the care of mass casualties.

The Role of the Dental Officer*

By

CAPTAIN J. V. NIIRANEN, DC, USN†

FOR human beings, existence depends upon the ability to meet and withstand unforeseen and unpredictable events. Some events occur by chance; others result from the plans and designs of people. But the occurrence of such events is commonly accepted, and human beings survive because they plan and prepare for events even though they cannot tell when they will occur.

One type of event which we must anticipate and against which we must prepare is a disaster. Disasters may be of natural origin, such as floods, hurricanes, and similar phenomena, or they may be precipitated by human actions. In this category could be grouped bombings with atomic or thermonuclear weapons. But, whether natural or designed, disasters produce the same kind of results. There are mass casualties, loss of power, loss of water, and failure of mechanical communications. Our dependence on these commonplace items of civilization, and our lack of personnel trained to care for casualties, make casualty treatment under disaster circumstances a major problem.

In this paper, we shall examine the relation of the dentist to casualty treatment in event of disaster. As it will be presented here, the examination will fall into three parts. First we shall consider the problems associated with adequate casualty treatment under disaster conditions. Next we shall consider the part which the dental profession might play in such circumstances. Finally we shall review the training program followed by the Naval Dental Corps as a source of suggestions for casualty treatment training.

A realistic approach to the consideration of disaster conditions will emphasize one conclusion. It is simply this: we *must* include attack by atomic or thermonuclear weapons among those disasters for which we prepare. Ultimately, our survival from such an attack would depend in part upon the nature and extent of our preparation for it.

Mass casualties will not be the only problem we will face in the event of atomic disaster. We are accustomed to facing the vicissitudes of life with the facilities of civilization at our disposal. Even in the event of natural disaster, some of these remain for our use. Moreover, in the warfare of the past—even in the saturation bombings of the cities of Europe—some facilities always remained. The city itself was never completely knocked out, nor were all of its essential services destroyed.

The picture of atomic warfare in the hydrogen age is entirely different. It presents only complete havoc and utter destruction of the physical make-up of a city. In such a disaster there would be no remaining transportation system, food supplies, communications, water, sewage disposal, electricity, or anything of the sort. It is estimated that 80 per cent of the hospitals of each of the target cities of the United States would be knocked out with but one well directed bomb in each of the cities.

It will be readily seen that the problems of treating casualties under such conditions will be multiplied manyfold. And even before we can consider the matters of facilities, or supplies, or personnel needed, we must recognize the vital need for the greatest possible cooperation between all existing services.

Although the medical problem will be of immediate concern in recovery from an atomic disaster, the success of the medical

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The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

effort will be dependent upon full cooperation between the health services and other services in the Civil Defense organization. It is important that the medical, dental, nursing, and allied professions, those holding key positions in the recovery team, have an understanding of the problems and limitations of other services in the organization so that the smoothest functioning of all toward the common goal may be effected. In the absence of many services which are normally taken for granted, personnel concerned with medical recovery will have to improvise and to rely on their own resources. The realization will be necessary that each has his own difficulties, that each must rely on himself, and that each will help the other as much as possible. This is primitive living, but it may make survival possible.

It has been said that our ability or inability to cope with the medical problem associated with atomic disaster may well determine the survival or nonsurvival of the Nation.

But supplies and facilities, even in abundance, are of no value in disaster unless trained personnel are available to put them to proper use.

The problems associated with treatment of casualties under atomic disaster conditions may be subsumed, therefore, under three heads: namely, facilities, supplies, and trained personnel. The next question is, What part would the dental profession play in such circumstances? Since one can readily understand the need for everyone who is even remotely associated with any of the health services to ally himself with the Civil Defense effort, the role that the dentist can play begins to emerge more clearly. As a health profession with a valuable advanced casualty care potential, dentistry has a unique responsibility to contribute a large part of well trained personnel to this effort.

The background of the dentist identifies the profession as well prepared, and as the most available group to amplify and extend the services of the physician. The 90,000 dentists of this country, with their sound basic medical science training, their experience in handling patients under various conditions, their close association with their medical colleagues in the mutual care of patients, are ideally qualified as a group of very able assistants to the medical men in providing emergency casualty care.

The dentist can provide assistance in any one of three ways. He may provide direct emergency care through administration of anesthetics, parenteral therapy, or the treatment of wounds, burns, shock, or radiation problems. Secondly, he may provide administrative assistance, perhaps by assisting in sorting and classifying casualties, or by organizing groups for cooperation of effort, or by arranging for provision of needed facilities and supplies. Thirdly, he may train others in casualty treatment. But, whatever avenue his efforts might take, he should be able to provide emergency casualty treatment, whether it be only for members of his own family, and perhaps his neighbors, or for many others beyond his personal associations.

When we are thinking, however, of the services which the dentist might render in emergency, let us make this distinction. To say that he is better qualified than others to extend the services of the physician is not to say that he is able to do it. Just as clinical practice is necessary to develop the skill required for the practice of dentistry, so practical training in casualty treatment is needed to develop the skills which would be demanded in a disaster situation with all its attendant hysteria and absence of controls.

If dentists are to be expected to act in a capacity which is quite outside their normal professional services, and in which they have had little or no practical experience, they must have proper and extensive training to prepare them to accomplish satisfactorily the expected actions.

If this point of view is accepted, the question becomes, How shall the dentist be trained for the role he is expected to fill?

Perhaps the most important consideration is the planning and formulation of a training program. The program should be carefully considered and planned as a whole, for

the types of training which are adopted and the manner in which they are used will determine the program's success. No recruiting drive should be undertaken until a worthwhile training schedule has been set up, because nothing will discourage a group more quickly than a poorly planned program.

If we think first of the courses which would be appropriate for the program, we may assume that the initial course will be training in first aid.

The first aid training should be followed by advanced instruction in emergency casualty care. This may be arranged through cooperation of the local medical societies, medical schools, or dental schools. In addition, the American National Red Cross has arranged for special courses to be given to dental societies and groups of dentists. These will be taught on a professional level and, whenever possible, professional teachers will be provided. Training under rescue conditions at the FCDA School at Olney, Maryland, is available regularly to dentists. Key personnel should take the Administrative Course at Battle Creek, Michigan, to understand better the functioning of the various components of the entire Civil Defense organization. Courses of instruction should be followed by personal observation in handling accident cases in hospital emergency receiving wards or even riding the ambulance to the scene of accidents. There, dentists may see the practical measures of relief performed by physicians or other well trained first aid personnel.

Instructors for all courses should be the best obtainable to maintain a high interest level in a "noncaptive" group.

Sometimes the basic techniques of lifesaving and immediate casualty care can best be taught by selected laymen—firemen, policemen, and first aid workers who have had much practical and first hand experience in administering these services. They have learned their treatments from actual casualty care at the scene of disasters or accidents. Qualified medical teachers are usually available who will review and demonstrate both the methods of treating traumatic injuries, shock, hemorrhage, burns, and fractures, and also the techniques for venipuncture, tracheostomy, et cetera. It might be suggested that those men who have had combat experience are probably best qualified to teach from their battlefield background. The "multiplier principle" should be fully utilized, i.e., 10 people should be trained, each of whom would train 10 others, and so on. Full use should be made of FCDA training materials, such as books and pamphlets. Films are available for loan from the Federal Civil Defense Administration and the American Dental Association.

This brief discussion of training for the part which a dentist might play in event of disaster brings us to a closely related topic, and the final point in our present consideration. A review of the Naval Dental Corps program for training in casualty treatment is presented, not because the program is presumed to be the superior training course in all the land, but rather because it represents the best efforts of a group of professional men like yourselves to achieve an objective similar to your own—namely, preparation for survival in case of disaster. This review of the training is offered simply to make available to you information which you may wish to utilize as you devise your own program.

The training course described here has been developed over a period of several years by the U. S. Naval Dental School. Instructors for the course are naval dental officers, and course materials have been selected both from available literature, special courses, FCDA materials, and Navy films and other training aids. The 35 hour course of instruction includes lectures, demonstrations, films, practical application of first aid procedures on trainees, and practical application of procedures on available training aids. Practical trainee participation is stressed.

The lectures cover the following subjects:

1. Basic structure of Civil Defense and its application to the Navy.

2. The effects and potentialities of nuclear weapons.

3. Complete familiarization with first aid equipment, supplies, and their use.
4. Various categories of wounds, such as head and neck, chest, abdominal, and internal.
5. Control of arterial and venous hemorrhage.
6. Treatment of open and closed fractures.
7. Management of maxillofacial injuries.
8. Emergency opening of closed airways.
9. Burns.
10. Shock.
11. Parenteral therapy.
12. Medicaments.
13. Bandaging and splinting.
14. Resuscitation.
15. Psychologic first aid.
16. Field anesthesia.
17. Transportation of injured.
18. Radiation injury

During and after the lectures, training aids are used for practical applications of the subjects. Extensive use is made of a facsimile arm, neck, abdomen, manikin, and moulages, all of which were developed at the U. S. Naval Dental School in Bethesda.

I find it difficult to close this discussion without stressing the great urgency of the situation. *Immediate action is needed.* We should not wait for someone else to start procedures; we must initiate actions ourselves. *An appropriate and easy place to start is our own homes,* where we can accomplish personal immunization and make basic preparations for shelter, food, and first aid.

We hope that disasters may not occur, but, by way of keeping our powder dry, let us use our reason and prepare as best we can to survive in the event that they do. The first and one of the most important requirements to meet atomic attack is advance preparation. Unlike Pearl Harbor, we cannot afford to wait until after the attack to prepare. The time to do it is *now.*

Role of Medical Officers*

By

COLONEL KARL H. HOUGHTON, USAF (MC)†

AS ONE looks at the title of this talk, one might wonder why it is necessary to invest even ten minutes in discussing the role of the medical officer. Everyone knows that his job is to take care of the sick and wounded, as he has been doing one way or another under various titles since the beginning of recorded time. We think now, however, since the world has man-made explosions of the order of tests fired at the Pacific Proving Ground, that it might be necessary to look again at his job and, if necessary, do a little reevaluation. After listening to the previous excellent presentations, you are completely aware of the magnitude of the problem, and probably are already formulating in your mind just how you, as a medical officer, would meet this situation and how it might differ from your previous experiences.

I think we should first keep in mind the different problems associated with the early (first two days) and the late period following an atomic event. The role of the medical officer at the late times should not be dissimilar to the problems encountered during heavy casualty periods of World War II, and is something which many of you have already experienced and successfully handled.

At the early period, however, it might be that our thinking needs some reorientation if we are to meet this new situation. Part of the medical officer's job will be to prepare himself psychologically for medical and surgical situations, that will be to say the least, unique. All of us in the military have to some extent applied the philosophy of doing the most for the greatest number. Under these new conditions, this philosophy must be stretched to the breaking point. You will be forced to do a little for a great number of people. Just enough to get them on their feet or enable them to manage for themselves. Your judgment will be pressed to decide "should I give this patient ten minutes" or "should I help ten patients in the same time interval and maybe save six or eight of them?" I am using the word "save" loosely, of course, since it may mean just making a patient capable of feeding himself or crawling by himself to some sort of shelter out of the traffic.

Another side of the situation will be the onerous task of playing God and deciding whom to help. You won't have sufficient drugs or surgical material to handle all the casualties and will have to decide rapidly and without hesitation who will receive this perhaps life-saving material. This is not always simple—do you save the banker or the truck driver? Do you go right down the line of casualties taking them as they come, or do you pick out those individuals who might be the most valuable in terms of the rehabilitation period to come? Fortunately, or unfortunately, there are medical officers in this group who have been forced to make these decisions during their prison camp days under the Japanese. Each medical officer was guided by his own conscience and made his own decisions. As an example—you have a hundred amebic dysentery cases progressing rapidly to death. You have just enough treatment material for three to four cases. Who gets the drugs? Some of you remember the ward officer in the Philippines in the spring of 1942 with 60 to 100 patients dying of malaria on his ward, on being issued 100 quinine tablets, blithely passed out one to each man. Did he do his job or face his responsibility as a physician? He

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might have saved 4 or 5 of those men.

I am sure these problems have occurred to all of you, and I am only pointing out that one of the pre-disaster jobs of the medical officer is to think out some of these situations in advance in an effort to prepare himself for this very disagreeable task. Fortunately, under the conditions we are discussing this week, the time urgency of the problem will help the individual to make his decisions or at least help his conscience.

I see one of the biggest jobs of the medical officer to be the pre-disaster training of non-professional and para-medical people. This is not always a task that is looked forward to by physicians even though they are quite aware of the necessity. Many medical officers look upon training as a disagreeable task and have a tendency to slight the responsibility or perform it in an offhand manner. In their defense, we know that the average medical officer is swamped these days taking care of the patients in his waiting room or ward, but the training must be done if we are to accomplish our responsibilities in modern warfare.

Many physicians have very strong feelings regarding the capabilities and the responsibilities of our para-medical personnel. Of course, they have limitations, if one compares their training to the rigid requirements for the successful practice of medicine or surgery in our peacetime hospitals. Nevertheless, the medical officer must be prepared, in the event of atomic disaster, to give them responsibilities unthinkable today. I see the medical officer with hundreds of casualties lined up, acting mainly as a roving consultant, dispensing advice rapidly to his assistants or the patients themselves. It is going to take a lot of team work, and I again see the medical officer as the leader of the team. Remember, I am still talking about the first day.

During the course of our military or professional lives, we have learned to plan and rely on the existence of at least minimum facilities and tools. Our job as of now is to think how we can operate with, shall we say nothing. You have seen Hiroshima and Nagasaki movies and heard the audience's reaction to scenes showing typical Japanese wards. They were not ideal but the best that could be devised under the circumstances. All that I'm trying to get across is the responsibility of the medical officer to start thinking of improvisations either in the way of facilities or medical supplies; thinking of things that will help "get him by" the first day or so. It may be that personality alone will do it. I've seen that happen with hundreds of sick and wounded lying around and neither facilities nor medicine available for the patient. A pat here and a little chat there seemed to help the patients. This so-called bedside manner is easy at home now, but under the circumstances we are discussing, it is a little more difficult. Whether we can mentally prepare for it or not, I don't know, but we should try.

It is hard to discuss the role of the medical officer without drifting into some of the other talks on this very comprehensive schedule, but I can think of one other role that, perhaps, can be one of his most important jobs. Within my experience, most medical officers in time of stress stand up well to the situation. It may be their training or the basic temperament that led to their studying medicine in the first place. It is easy to visualize the hysteria and panic that might be present under these circumstances. You know that in practically every crowd or group assembled at an accident there is some would-be-leader screaming for action even if it means throwing the injured in a car—doubling or tripling the initial injury—and go screeching down the street wide open, horn blowing. The physician or medical officer is the most likely and perhaps the best qualified individual to inject a note of sanity in the proceedings and to act as a rallying point for law and order. The medical officer, by his bearing and attitude, can assist in this problem without thinking of it as an added responsibility. It will be the manner in which he is handling his associates and patients that will stand out as a focal point of order.

One might say that this would not be a problem with well-disciplined troops. It might not be, but there will be many situations where there will be a mixing of civilian and military populations.

Some of my comments might be quite controversial, and they may well not express the opinion of the majority of us present today. They are, however, based on experiences during the last war and, in my mind, represent after a fashion some of the problems forecast for World War III, if it should hit us. Anyway, they may give you something to think about, and if that is so, right or wrong, I have not completely wasted your time.

Organization for the Management of Mass Casualties: Summary and Discussion*

By
BRIGADIER GENERAL H. W. GLATTLY, MC, USA
Surgeon, First Army, Governors Island, New York

IN THIS symposium on the care of mass casualties we have considered another aspect of the problem. The first two days of the program were devoted to the physical effects of nuclear warfare, the character of the casualties that would eventuate from an atomic disaster, and the principles to be exercised in the care of the injured. The remaining portion of the symposium is devoted largely to organization and management such that maximum utilization will be made of all available medical means to include personnel, facilities and supplies. It can be stated categorically that without good organization the medical efforts following an atomic disaster will be largely ineffectual. The subject therefore assumes a place of major importance in this symposium.

We have been presented this morning with nine very stimulating papers, each of which covers a particular facet of the overall problem. The essayists are to be complimented upon the vast amount of material covered in so short a period of time. The papers fall into two groups. The first two discussed the initiation and establishment of certain very vital sanitary and public welfare services in the disaster area. The remaining seven presentations related to the utilization of various categories of medical and para-medical personnel.

As you listened to the papers, I am sure you were impressed with the number of almost identical principles that were emphasized by the speakers. In summarizing I think it would be well to review these common denominators. There was general agreement that:

1. Our total national resources of individuals engaged in the several health professions will be grossly inadequate to satisfy the medical problem following an atomic disaster.

2. In spite of the magnitude of the medical problem, a great deal can be done to lessen the effects of the disaster by adequate training and planning prior to the event. The attitude of futility that today characterizes our population must be broken down.

3. In the period immediately following the disaster improvisation will in general characterize the medical effort. This will apply to personnel, facilities and supplies.

4. To achieve maximum results it will be necessary to upgrade, professionally speaking, the duties of all categories of medical and para-medical personnel.

5. All personnel engaged in disaster relief must be thoroughly imbued with the philosophy of doing the most for the greatest number. This very important principle was especially well presented by Colonel Karl Houghton in his paper on the role of the medical officer.

6. The extreme shortage of physicians and nurses will be such that the initial care of casualties will be largely dependent upon the resourcefulness of lay individuals to direct and to give simple first-aid care. The value of the lay individual who has received a certain amount of first-aid training was well presented by Miss Hauge in her discussion of the role of nurses. She also made what I think is a most important point when she emphasized the necessity to develop a program of a type to maintain a continuing high level of interest on a long-term basis.

7. In general it can be stated that both the medical profession and the lay population

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are untrained with respect to meeting an atomic disaster. The keynote of each paper presented this morning has been the necessity to immediately develop and implement appropriate training programs for our entire population.

The Federal Civil Defense Administration and the Armed Services have developed training programs appropriate for all skill levels. The major problem in civil defense today is to actively implement these programs.

ORGANIZATION FOR MANAGEMENT OF MASS CASUALTIES*

Introduction to Problems

By

RUFUS L. HOLT, M.D.†

IN ANY organization for the management of mass casualties following attacks with nuclear weapons numerous decisions will have to be made which will necessarily conflict sharply with our innate sense of humaneness and fairness. As an example, we must conclude in advance that blood and plasma will be in short supply and it may very well be that expanders may not be available in sufficient quantities. Necessarily, then we must husband our supplies of these materials and use them exclusively in attempts to salvage those individuals who are not doomed before they come to the attention of medical personnel. To follow any other plan does not appear to make sense. Disposition of our casualties may have to follow the same pattern, hard as it may seem to those of us who have to make decisions in the matter.

Vannevar Bush,‡ in a recent address, has stated what a critical situation we would face in atomic warfare by declaring that "the test is upon us now and will not wait. We must grapple with it, using the systems of social relation that we have and such wisdom as we can master. Whether we come through the ordeal will depend upon whether we are sufficiently mature to map out a wise path and adhere to it."

This states exactly what we must do if we are to survive in numbers sufficient to rehabilitate our surroundings and salvage our manpower.

It need not surprise us then to hear some recommendations made by our speakers which, while we realize they are necessary, may sound callous to an extreme degree. Actions based upon such recommendations may represent the sole means of survival.

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‡ Bush, Vannevar: "Science & Progress," American Scientist 42:241 (April, 1955).

Training for the Management of Mass Casualties*

By
COLONEL HALLMAN E. SANDERS, USAF (MC)†

PRESENTATIONS by previous speakers on this program have covered with complete clarity and proper emphasis the magnitude of the many problems dealing with mass casualties. The utter chaos, disorganization, panic, and devastation which can be caused by the detonation of multiple nuclear weapons are practically inconceivable to the mind of the average individual. To render immediate first aid and early medical assistance to victims in the face of such frightful odds staggers the imagination. Thus, prior planning and proper organization in the event of disaster is the only conceivable manner in which to cope with situations of this kind. This means that all persons capable of self care should be trained how to react and what is best for himself and his fellowman in case such a catastrophe strikes home. The first ingredient in such training is to acquire the basic knowledge of first aid and rescue operations, also to develop an organization for an all out medical effort. This training should have a high priority in communities adjacent to industrial centers and other prime targets. It is essential that all able-bodied persons of the entire adult population receive intensive first-aid training. All high schools should have a similar type program for students. A modified type of indoctrination is indicated for all pupils in the junior high schools in order to standardize the basic elements of a knowledge of first aid. The American Red Cross is well equipped to enlarge training activity in this sphere, and each State and community should develop a program to teach first aid. This will consist of self-aid, "buddy aid," and aid rendered by rescue teams.

PRELIMINARY CONSIDERATIONS

The concept of "management of mass casualties" is of relatively recent origin. When we think of providing medical procedures on short notice to a vast multitude in a disaster area we think of furnishing an all out initial medical effort of emergency medical care. Now this type of assistance and treatment is of necessity more advanced than ordinary first aid. It encompasses lifesaving and life sustaining measures used by anyone whether unskilled, semi-trained or professional, available in or near the disaster area. This will be done in an effort to salvage human life until (1) skilled medical teams can be brought to the patients, or (2) to give emergency aid to help prepare the injured to travel to a near or remote area where modern type civilian medical and surgical centers can provide definitive treatment. This concept stimulated thinking in relation to patient care in the event of a major catastrophe occurring within our boundaries resulting in hundreds of thousands of casualties. We need a realistic approach to this type problem with the rapid mobilization and movement of trained medical personnel and medical supplies to the disaster area to render immediate assistance and evacuation.

There are always aggressor nations and our armed forces must exist in a state of constant preparedness, and of course this requires training of all personnel because there is really no place in the services for an untrained military man. We cannot afford a weak defense and our passive defense measures are aimed to reduce human casualties and minimize destruction of vital resources.

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† 3882d School Group, Gunter Air Force Base, Alabama.

The problems of civil defense are closely related to the role of military medicine. The urgent need for preventive measures to reduce the hazards to a minimum, also the ability to immediately furnish a medical service capable of providing adequate early treatment and preventing undue suffering, thus saving as many lives as possible, furnishing essential health services to a community and insuring minimum disability among civilians. In order to salvage human lives in target areas it is necessary to have evacuation plans, air raid shelters, rescue teams, fire fighting squads, makeshift hospitals, and the sorting and treatment of the injured—this effort primarily by civilians to save other civilians. In such instances there is need for the efficiency of the military system—the prior planning, the training, the practice drills and the discipline to work for the common good of all. Independent organizational efforts must be integrated into the community defense plan. Dr. Casberg has previously pointed out the modern concept of warfare in relation to civilian populations; that there will be no differentiation between the civilian and the military, and the fact that the efforts of the civilian members of the population are as essential to the survival of a nation as the efforts of the combat forces.

The opportunity for the prevention of mass trauma is during the predetonation phase of any attack using atomic or thermonuclear weapons provided, of course, there is sufficient warning of an attack and early evacuation from critical target areas. One of the greatest problems that confronts any nation today in the event of war is to be prepared to render first aid and proper treatment at a moment's notice to mass casualties. Preparedness requires training, not complacency or wishful thinking. In order to save lives and prevent disabilities resulting from an atomic attack there is a firm requirement for the availability of physicians, medical technicians and other properly trained personnel near at hand and in sufficient numbers to render immediate assistance including triage, emergency care, evacuation and disposition.

TRAINING OF MILITARY PERSONNEL IN THE PRINCIPLES OF CARE OF MASS CASUALTIES

It is not the purpose of this paper to enter into Civil Defense planning, also it is proper to emphasize that the subject "Training" in the title refers only to medical training of military personnel. In the event of attack upon the United States, it is anticipated that the medical units of our armed forces will be moved into the disaster area to work in unison with the civil defense efforts.

Medically trained personnel of all categories will be used according to their highest skill in providing emergency medical care to the injured. These individuals will not normally be involved with first aid, rescue, transportation or labor functions. Medical personnel will be used in medical treatment facilities. The armed services will furnish mobile and semi-mobile medical support units, supplies and transportation. All military hospitals should have trained surgical and burn teams available for dispatch to a disaster area within the space of an hour or two. Movement will be by air, motor or rail according to a previously arranged plan.

1. Military Training Objective

The objective of such training is to provide military personnel with the necessary knowledge of procedures and techniques to be used in the event of disaster. Except for members of the medical profession there is a continuing requirement for the training of first aid and rescue measures to personnel of all units. This should be accomplished by regular demonstration periods, also question and answer sessions, in order that such training be practical and realistic. Teaching the bare essentials is indeed a formidable task. It requires proper motivation to stimulate the student, adjusting conditions to insure the learning process, with participation in practice exercises and repeated drills.

2. Training Program

This program must be adequate and in order to provide sufficient range should cover such items as individual, unit and combined training. There will be one schedule for all military persons other than those assigned in the medical service; another schedule for various categories of medically trained personnel with special emphasis on cross training in certain areas and enhanced professional type training for medical technicians, paramedical personnel and physicians. This additional training for all individuals possessing different degrees of medical knowledge in order to increase their skill level in relation to caring for traumatic injuries. Each individual should be issued small pocket-sized manuals on First Aid and Defense Against Chemical, Biological and Radiological Attack (Example: Air Force Manual 355-8) and encouraged to become thoroughly familiar with the contents.

3. Categories of Personnel Receiving Training

A. *Non-medical Personnel*

"Under first aid must be considered physical trauma, burns, radiation injury and radioactive contamination." It is readily recognized that all officers and enlisted men and women should have a knowledge of basic facts regarding first aid sufficient for the individual to give intelligent care to himself or to others in case of an emergency. The standard minimum training should include:

(1) Control of hemorrhage and prevention of shock.
(2) Removal of torn clothing and application of dressings.
(3) Emergency care and protection of certain wounds.
(4) Emergency splinting of fractures.
(5) Handling and transporting the injured.
(6) Artificial respiration.
(7) Evasive action from Chemical, Biological and Radiological warfare hazards.

Key officers and noncommissioned officers should be trained as instructors in first aid and receive additional indoctrination in respect to the application of individual and unit protective measures against special weapons agents.

B. *Medical Personnel*

(1) *Enlisted.* Specific training in regard to principles of first aid for injuries resulting from physical trauma, burns and radiation injury. The scope of this training must be more advanced than the previously mentioned subjects applicable to non-medical personnel. Minimum training should include:

(a) Cause, prevention and emergency treatment of shock.

(b) Methods of protecting injuries from infection and controlling hemorrhage.

(c) Application of bandages and dressings.

(d) Indications for and methods to administer artificial respiration, insuring a patent airway and proper positioning.

(e) Emergency treatment of fractures, dislocations and sprains, including the improvisation and application of splints.

(f) Precautions to be taken when handling and transporting the injured.

(g) Understanding of atomic, biological and chemical warfare hazards in order to effect evasive action.

1. Rest for radiation victims.
2. Principles of decontamination.
3. Avoiding contamination from CBR residues.

(h) Priority of movement of certain urgent cases to patient collecting points. (Examples: Abdominal wounds, chest wounds, open fractures, burns involving 20% body surface or more and pharyngeal burns. In the latter instance there is noted burned nasal hairs and hoarseness.)

(i) Warning regard the use of a tourniquet "to sacrifice a limb to save a life."

Basic Medical Training for Medical Enlisted Personnel

Early training is provided in the usual instance following or within a relatively short period after basic training or boot camp. Personnel considered eligible for a formal

course of instruction are assigned to apprentice level schooling or hospital training in one of a dozen or more specialized fields of endeavor within the medical service such as: Dental Service, Dental Laboratory, Preventive Medicine, Medical Service, Surgery, Medical Administrative, Medical Material (Supply), Radiology, Medical Laboratory, Physiological Training, Aeromedical and Pharmacy. Usually the student's introduction into the medical career field covers a great deal more material than is given in a first-aid course of instruction. However, since these individuals will serve with the medical service, it is advisable that this phase of training incorporate more advanced first aid and certain aspects of emergency medical care into the curriculum. Particular emphasis upon augmented training of surgical and medical service specialists to understand the principles of resuscitation and urgent surgical procedures.

CAREER ENLISTED TECHNICIANS OF THE MEDICAL SERVICE

During an individual's military service he is given ample opportunity for advancement and additional training in his chosen field in the medical service. He increases his skill by individual study, on-the-job training, supervised work and more schooling. He must achieve a certain level of proficiency in relation to job performance, and he receives promotion in rank on the basis of achievement and length of service. As the individual advances he attains a rather high degree of specialization in the sub-professional sphere. Therefore, if he is to become of increased value in the realm of serving the medical service in the event of a major catastrophe, he will be more useful if he attains additional knowledge and training in disaster medicine. It is imperative that he receive cross training for utilization in work associated with emergency medical care. This should include information and techniques in sound medical practices of care of traumatic injuries as follows:

(a) Effects of nuclear weapons—Blast, Thermal and Ionizing radiation.

(b) Types of mechanical injuries—Contusions, abrasions, lacerations, crush injuries, penetrating wounds, amputations, avulsions and perforating wounds.

(c) Common location of injuries—head, face and neck, thorax, abdomen, upper extremities and lower extremities.

(d) Types of thermal injuries—Flash burns (profile) and flame burns, including degree and extent.

(e) Radiation injuries—prompt effect and residual effect.

(f) Concept of standard type measures for treatment of the various injuries mentioned in relation to management of mass casualties. Principle of lifesaving care near the scene of disaster.

(g) Basic elements of bedside nursing care.

(h) Principles of sorting (triage) patients—by way of information explain that this requires a physician; that mature professional judgment and clinical experience is invaluable in deciding the priority of cases.

(i) Identification of patients—Accurate data for Emergency Medical Tags and importance of keeping an adequate record.

(j) How Civil Defense is organized and the usual chain of evacuation via litter bearers to litter collecting points to First-Aid Stations. General principles of types of evacuation from the disaster area.

(k) Air Evacuation—Moving the injured early via helicopters and large aircraft insures rapid transportation to large civilian and military medical centers, also lifesaving measures and even hospital care en route. Means less dislocation of the civilian medical economy in war.

(2) *Training of Certain Officers of the Medical Service.* Recently the Department of the Army published a special training circular which directs minimum training of certain officers of the Army Medical Service in the active Army, the U. S. Army Reserve and the National Guard. The objective is to provide minimum essential training in emergency medical care for all Dental Corps, Veterinary Corps, Army Nurse Corps, Medical Service Corps and Army Medical Specialist Corps officers of the Army Medical Service. The content of this special in-

struction is a minimum of 12 hours of training by Medical Corps officers on the subjects of: hemorrhage and shock, burns, fractures, unconsciousness and artificial respiration, treatment of wounds, dressings and bandaging. Details of initial treatment will be thoroughly covered during the course of this training. Complete lesson plans and references are furnished to conduct this program. It is advocated that the Medical Service of the other Armed Forces adopt a similar type program since it is paramount that all these officers be trained to assume added responsibilities in the event of disaster. Many officers are already receiving instruction in Radiobiology.

(3) *Special Training for Dentists.* In addition to the above-mentioned content of training, dentists should receive special instruction in administering anesthesia, giving whole blood and plasma volume expanders, performing tracheotomy and assisting in surgery. Many dentists are trained as oral surgeons and will be of invaluable assistance in caring for facial and head wounds.

(4) *Special Training for Nurses.* Nurses should have increased responsibilities, both technical and supervisory, during disaster periods to include:

(a) Debridement of wounds in certain areas.

(b) Administration and supervision of giving drugs and injections.

(c) Duties of nurse in charge of patients during air evacuation.

(d) Pass suction tube on abdominal cases.

(e) Nurse anesthetists can supervise several operating room cases using untrained assistants.

(f) Regulating flow of work load and clearing all patients capable of duty or self-care.

(g) Establish priority of patients for urgent medical check-up by physicians.

(h) Conserve and control use of medical supplies.

(5) *Special Training for Physicians.* (a) Additional instruction in: resuscitation; essential surgical measures and caution regarding early treatment; definitive medical care—the proper treatment of specific types of injuries; principles of triage—the importance of the physicians supervisory role in the early post-catastrophe period; standardization of treatment and procedures for management of mass casualties; and problems of radiation injury.

(b) Practical training of all young physicians in: Early care of traumatic injuries including urgent priority of surgical treatment of certain wounds; Surgery of trauma, life-saving surgery (tracheotomy, and primary debridement; administration of anesthesia and other special problems; modern concepts in the treatment of burns; and early care of fractures—particular attention to treatment of open fractures.

Summary and Conclusions

There is no ideal solution for the immediate management of mass casualties either for domestic catastrophies or to support an all out war effort. It is obvious that there is no question about the benefits to be derived from the early treatment of all casualties. It is also obvious that such a feat is impossible due to the vast numbers that would simultaneously require definitive treatment. However, there are measures to be taken to alleviate the suffering, save lives and reduce complications of major injuries. The chance of survival of the hospital type cases will be influenced by: (1) Promptness and the scale upon which quick aid and rescue work can be accomplished; (2) The rapidity of mobilizing and controlling workers, vehicles and aircraft; (3) The ability of medical teams to give emergency treatment, sort and evacuate needy patients to nearby or remote areas for definitive care.

This gigantic effort requires wholehearted teamwork of all individuals and agencies involved. We need the best utilization of medically trained manpower during the period of national disaster since this type catastrophe is essentially a medical problem requiring heroic measures. The shortage of physicians to cope with the overwhelming medical problems presented precludes adequate planning on the basis of the medical

team concept to deal with specialized care on the spot for all the multitude of gross injuries sustained. The awesomeness of the task at hand dictates prior additional training of medical technicians and paramedical personnel, and the increase in the training of greater numbers of these individuals. Their role will be markedly increased in relation to enhanced responsibility for patient care and comfort. Interns, residents and all military physicians should receive additional training in the care of wounds and the principles of early surgical care of traumatic injuries. Under the program of Medical Education for National Defense (MEND) inaugurated in 1951, more medical schools are becoming affiliated each year. This theme was developed as a means of teaching military and civilian personnel in disaster medicine.

Military medicine is geared to the plan for early and speedy evacuation of patients. To be prepared for a major catastrophe all members of the armed forces should receive special training in care of the injured. Nonmedical personnel should receive an intensive first-aid course. Medical personnel should have special instruction on the subject of emergency medical care. All medical service officers must be trained to assume increased responsibility in relation to sound medical practices and actual treatment of patients in order to save lives and relieve human suffering.

Civil Defense, civilian medicine and the armed forces of this nation, including reserve and National Guard components, must work hand in hand when there is a requirement to render an emergency medical service for mass casualties. A tremendous effort of this type requires careful planning and complete coordination with many agencies.

Organization for the Sorting of Casualties*

By

LIEUTENANT COLONEL JOSEPH D. GOLDSTEIN, MC, USA†

IN ANOTHER paper Colonel Hartgering presented the mechanics and objectives of mass casualty sorting. I shall discuss various considerations pertinent to the planning for the organization of a sorting facility and submit a method for implementing this activity.

Sorting or triage is the process of grouping sick and wounded according to the type and urgency of injury. Its purpose is to promote prompt and proper patient disposition consistent with the prevailing tactical situation and medical capabilities. In theory we may regard sorting as an independent activity. In practice, however, the very nature of the patient compels the blending of sorting with emergency medical care and evacuation. Planning the organization of one at the exclusion of the other is neither sound nor real. Generally, these activities occur throughout the entire medical treatment chain. In conventional warfare their achievements are matters of history. Specifically, the use of mass destruction weapons understandably will cause a large increase of casualties both in number and rates. This increase reasonably requires a restudy of our organizational structure and capabilities to meet this special situation. I place emphasis on the fact that we are dealing with a particular type event. Accordingly, we must explore it as another special requirement of the medical service. This does not detract from the fact that it well may be the most important requirement in future conflicts. It follows that we should use and adjust our available and tried basic means rather than seek and chance special devices championed at best by theory. This is especially true when we must plan for the immediate with what we have now. This in no way precludes the adoption of sound evolutionary changes indicated by and resulting from future developments.

We return to the immediate problem of organizing a sorting station or area. This station must be capable of implementing a family of associated tasks as follows: (1) sorting patients for return to duty or priority for further treatment, (2) providing emergency medical care, and (3) preparing patients for evacuation. To be sure, these activities will vary quantitatively with the level of the medical facility concerned and with the occasion. Nevertheless, the same general operating principles and basic medical tenets will apply. I will proceed to set up a sorting station organization within the framework of the three following assumptions:

(1) A wide disparity will in all probability exist between the patient load and medical resources.
(2) All available medical forces will be used to the maximum for the care of the wounded.
(3) Number and rate of admissions will be beyond the authorized patient loads of presently organized medical facilities by a ratio of at least 5 to 1 or more.

In additional to these assumptions, many variables will manifest themselves as matters of the moment. Among these the non-medical rescue capabilities, location of the disaster in relation to supporting medical facilities, the size, number and time interval between nuclear weapon attacks will impose major influences. Logically, purpose and direction demand that our organization be built to satisfy a three-way functional cri-

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terion. First, it must be firm to meet the foreseeable. Second, it must be flexible to adjust to the unpredictable. Third, it must be oriented to return to the normal.

I submit two concurrent approaches to the organization of a mass casualty sorting station to meet possible future needs. One concerns itself with the personnel and the other with the physical plant. I offer these concepts for your consideration not as accepted doctrine of the Medical Service but rather as personal views crystalized from serious examination and evaluation of the subject. We have established the technical objective of a sorting station on the one hand namely, classifying, treating, and preparing patients for evacuation. These things we know. On the other hand, we have recognized the ultimate patient load to be relatively large but not exactly known. The known requirements can be met proficiently by a well-balanced medical team with a calculated patient capability. The unknown numerical work load can be met feasibly by a varying combination of such teams as the situation dictates. Obviously, where appropriate and intact TO and E organizations are available for use as forward sorting stations, their choice is self-evident. A clearing platoon exemplifies this type unit. However, one can envisage many exigencies that will dictate the employment of provisional forward sorting stations that will be improvised from larger parent organizations located in the general vicinity of a disaster. To this end I propose that teams be organized within the existing normal organizational structure of the parent unit. I feel that the Medical Detachment (Team OA), a time-tested unit, is particularly suited as a basic working pattern for such a team. It includes one Medical Corps officer and eight enlisted men. It is small enough to be handled with ease and large enough to do its assigned mission. It lends itself to mobility, flexibility and cohesive effort for either independent or integrated operations. By various combinations any size sorting station could be fabricated from these basic functional units, with its mission clearly defined by standing operating procedures.

Let us examine a graphic representation of the functional organization of a proposed team.

The medical officer is centrally placed and forms the team's cohesive core. He directs his supervision and control outwards towards the enlisted men in the circumference of the circle. He regulates his influence to all or any member of the team. His contact to each one is direct and there are no intermediaries or "low men on the totem pole." He conserves his professional talents for sorting, supervision of patient care and such essential emergency medical treatment that require his personal attention.

The individual members are all trained and assigned to primary medical tasks as well as secondary ones to insure operational depth of qualified personnel within the cell. Initiation of individual action is not dependent on any other individual (E.M.) and therefore is not delayed because of absence of any enlisted member. Each man is trained to translate the officer's decisions, under appropriate supervision, into actual patient care and disposition.

Admittedly there are certain other functions such as essential housekeeping details, transportation of patients within the station and communications. For these, extra hands are required. They may come from other military or non-military sources. It behooves the individual team member who is assigned one of these specific tasks to estimate the kind and amount of assistance he will need. These estimates are then evaluated, consolidated and coordinated through and by normal channels. At worst, even though this assistance may not be available or adequate, the deficiency at least will be noted early, and some remedial steps taken. At best, the additional personnel requirements will be known before the event, thereby allowing sufficient time for their procurement and planning for their activities with proper supporting agencies. Control of this segment mirrors that of the team.

What is the potential capability of such a sorting team in a forward area? Studies at the Walter Reed Army Institute of Research

indicate that a sorting station consisting of three such teams can handle an integrated patient load of approximately 1,000 cases in the first 36 hours after impact. Such a station may have a combination of two teams with Medical Corps officers and one with a dentist. This arrangement simultaneously would conserve the limited medical officer pool, yet assure one physician on duty at all times and allow for necessary rest periods.

This arrangement need not conflict with the standard existing command structure for normal operations. In fact, it enhances both normal "up and down" communication to multiple team commanders and lateral communication within and between these units. Summed up, this means an informed command which in turn favors a controlled command with the added bonus of decentralized control, a most desired feature in view of the anticipated disruption incident to a nuclear weapon attack. Other advantages that accrue to this plan are:

(1) Responsibilities and missions can be defined clearly and directly.

(2) Individuals are motivated by becoming active and identifiable parts of a team.

(3) Teams become familiar with and directly responsible for the organizational equipment which they themselves will use.

(4) Parent organization commanders gain maneuverability within their units.

(5) Commanders can test the proficiency of any component team either separately or combined.

(6) Commanders of medical facilities, fixed or field, can respond in a rapid and planned manner to any emergency request by Area Damage Controllers for the dispatch of mobile medical teams which, in essence, are the sorting teams.

(7) Team re-entry into parent unit activities can be phased and directed with relative ease.

The doctrine as presently taught and practiced in Area Damage Control Plans provides for mobile medical teams. Since these ADC plans concern themselves primarily with the administrative and logistic areas in which we find the major medical facilities, their interest in the need for preparing such mobile teams is clear.

The second aspect of a sorting station deals with the actual physical layout. Facilities may vary from ideal structures such as warehouses, depots, auditoriums, etc. to an open field. For my purpose I will use an open field, the most likely available item at the time, and visualize a sorting station operating independently during the immediate post-impact period.

A schematic representation of such an area points up the following:

(1) the central area for such concomitant activities as admitting, recording and sorting of patients in addition to ordering the essential emergency treatment;

(2) the separate areas for the sorted patients where the prescribed treatment is either initiated or continued;

(3) the accessibility to avenues of return to duty or evacuation transport respectively;

(4) the general location of other essential activities which may or may not be provided by the Medical Service.

In the final analysis the technique used for the organization of any given sorting facility will be influenced by local factors. Far more important is the assurance that those responsibile for planning sorting activities will do so before the event and that such plans will be based on what is known, what is expected and what can be done realistically and feasibly. The planned mission should always be "doing the *most* for the most" but the motivation must be "doing the *best* for the most" within the prevailing resources.

Expansion of Army Hospitals*

By

COLONEL WILLIAM S. MOORE, MC, USA†

IN THIS paper I hope to give you a fairly good idea of the organization of fixed and field hospitals operated by the United States Army. More specifically I will present the highlights of the plan of Army Medical Service for the rapid expansion of these hospitals to the maximum extent possible in preparation for the handling of mass casualties.

To understand The Surgeon General's approach to standardization of organization structure in fixed hospitals, it is necessary to be aware of the following fundamentals. The ever increasing pressures for greater economy of means in the operation of our hospitals make it imperative that the organizational structure used be designed with this in mind. A greater degree of efficiency is achieved through the establishment of uniform position patterns, standard administrative procedures, work measurement and the accurate determination of personnel requirements. Also, standardization of organizational structure enhances the accomplishment of valid inter-hospital cost-of-operations comparisons and facilitates the utilization of cost data in the improvement of hospital operations.

Organization structure is usually pictured through the use of organizational charts. Figure 1 shows the organizational chart of a Class I hospital. Named Army hospitals are organized essentially the same. I present this chart merely to reacquaint you with the organization of our Army hospitals as they are operated today. Notice that there is no real difference between the organization of the Army hospitals from other federal or civilian hospitals.

ORGANIZATION STRUCTURE OF CLASS I UNITED STATES ARMY HOSPITALS

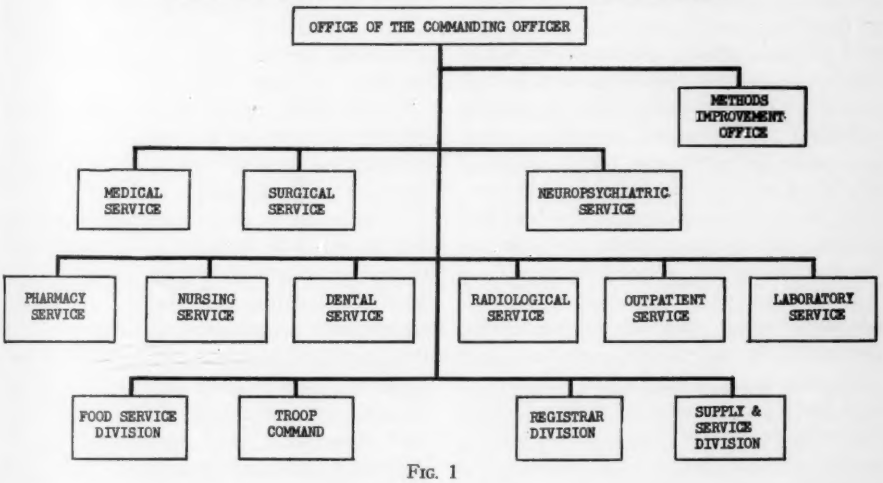

FIG. 1

Field hospitals are organized according to specific predetermined Tables of Organization and Allowances. Their primary mission is one of medical care and treatment for the sick or injured soldier. Each field-type hos-

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pital is specifically designed to support combat operations. The need for mobility makes it mandatory that they be organized on a more simple basis than the fixed Army hospitals.

The management of mass casualties is of vital importance. Consequently, it is mandatory that we plan for the adjustments required in Army hospitals in the expansion of these facilities for the handling of large numbers of casualties, if and when the situation requires.

In the past, it has been possible to give the Army hospital commander sufficient notice as to the number and type of patients as well as the approximate date of arrival at the hospital. Under those conditions, the hospital commander has had ample time to plan for the orderly processing, sorting and treatment of such patients. However, in future disasters or combat, there may well be lack of time for such planning. All of us who are concerned with hospital operations must have plans prepared and tested ahead of time if we are going to bring orderly treatment out of chaos and render the best type medical care possible under the circumstances. Ordinarily, a good hospital is a smooth functioning organization. Individuals know where they are to work, what they are to do, and the responsibilities with which they are vested. Sudden disasters or demands for tremendously increased workloads may necessitate reorganization and expansion on short notice. This requires prior planning if our capabilities are to be realized.

The previous speakers have emphasized the need for proper sorting, early resuscitation, and many other aspects for the proper professional handling of mass casualties. To be effective, the staff of a hospital must continue to operate with some semblance of order. Facilities, supplies, and equipment must be made as nearly adequate as is humanly possible. We will be confronted with the problem of making *additional hospital beds available*. The first step, obviously, is to move out of the hospital every patient who does not absolutely require hospital care. Also, since the existing plant probably cannot handle the increased workload, other buildings in the vicinity must be selected for possible use.

When disasters reach the proportions we have been discussing here, one is forced to think and plan in practical and simple terms. Complex procedures and methods of treatment and unnecessary administration will have to be discarded. Certain organizational elements of the hospital are greatly expanded while others become smaller or even lose their organizational identity.

The scope of care furnished by the hospital will depend on the source of the casualties. If they are received direct from the disaster area, the first consideration will be "life-saving" care. If the casualties are received by transfer from a medical facility where life-saving care has been rendered previously, the important requirement is to continue definitive treatment.

Under these conditions, we will need all the help we are able to obtain. Patients can certainly be used to help in the hospital, if they are physically able.

Areas must be established where patients can be carefully sorted and provided with emergency identification tags. A holding area for the ambulatory non-effective is a "must" requirement. "Ambulatory non-effectives," in this particular instance, refers to those patients who have received treatment for minor injuries and now require only shelter, food and observation until disposition can be effected. These are individuals who *must not* consume medical resources under such emergency conditions. Let us be frank with ourselves. We must never lose sight of the fact that every effort must be directed towards the mission of rendering the *most care*, of the *best quality* possible, *with dispatch*.

The Surgeon General has recently developed an outline for hospital emergency operating plans which is designed to assist hospital commanders in planning for the expansion of their hospitals to the maximum extent possible. Both the facilities and capabilities are taken into consideration. In planning for this expansion, hospital commanders must realize that "maximum ex-

pansion" should not be restricted to the existing hospital facilities. It may require the use of buildings not previously utilized for patients. Also, it may require the relocation of certain activities under tentage or other shelter. The main objective of this plan is to provide for the orderly expansion of the vital components of the hospital to the maximum extent possible.

Since all Army hospitals are organized essentially along the same lines, the organizational structure has been used as the point of departure in developing this guidance to hospital commanders. This approach will insure that the total resources of the hospital are utilized, and will assist the hospital commander in formulating his individual hospital plan.

In developing his plan, the hospital commander will undoubtedly decide that "low-priority" functions of the *normal* hospital organization will have to be discontinued during the emergency. This will permit the essential functions of reception, professional care, and disposition to be augmented. For example, we envision that the reception and resuscitation of casualties may be the overriding function of the hospital for some time. Consequently, plans should provide for the merging of the elements from the Surgical Service, Outpatient Service, Registrar, with supporting elements of nearly all other activities of the hospital.

We recommend that each hospital commander appoint a *Professional Disaster Committee* under the chairmanship of the deputy hospital commander, or chief of professional service. Also, there should be an *Administrative Disaster Committee* under the chairmanship of the executive officer. It is envisioned that these committees be made responsible for developing detailed plans for the professional and administrative care of all patients received at the hospital. These disaster committees should meet at least twice yearly for the following indicated purposes:

a. Reacquaintance with provisions of the plan.

b. Revision or further implementation of the plan where necessary or desirable.

c. Revision of assignments to duty and notification of affected personnel.

d. Testing various segments of the plan to determine performance as indicated.

e. Reassignment of space within the hospital to various activities as necessary.

Although these tasks have been delegated to subordinates, this in no way relieves the commander of his responsibility for the effectiveness of the plan. Additionally, the disaster committees, acting jointly, should be charged with the responsibility for testing the entire plan, conducting a critique, and reporting to the commanding officer the results of such tests once yearly.

Any emergency which occurs in the immediate vicinity of the installation or at the installation itself could result in impairment of operations which would require immediate adjustments. The hospital commander should not overlook this possibility in developing his local emergency plans. In preparing the hospital emergency operations plans we must start with certain assumptions. The assumptions *we have made* in the development of *our* plans are:

a. Mass casualties, particularly from atomic attack, may occur with little or no warning.

b. Normal communications may not be available. Preplanned alternate and possibly foot messenger means of mass notification to activate movement of personnel to specific areas of assignment may be required.

c. Mass hysteria may occur among civilian populace near the installation or hospital. Augmented and rigid internal security procedures in the hospital area, based on prior guard post assignments, instructions, and training, will be necessary.

d. Internal traffic control will be needed to guide ambulatory casualties, who require immediate treatment, to proper treatment areas. Prior assignments and training, plus preparation and storage of signposts in convenient areas for quick access and posting, will be required.

e. Present command and key officials may be immediate casualties. Prior instructions

for prompt assumption of key roles by surviving personnel will be required.

f. The admission personnel force will have to be augmented. Reception area(s) will be considerably enlarged. Prior planning in detail will be required.

g. Immediate casualty totals will require maximum expansion of the hospital in terms of beds and allied equipment. Prior instructions and training for utilizing other than wards for housing casualties will be required.

h. Professional treatment must be planned on basis of practices outlined in TB-Med "Early Medical Management of Mass Casualties in Nuclear Warfare."

i. Evacuation of casualties will be delayed initially. The disposition personnel force will have to be augmented. The disposition area must be considerably enlarged. Prior planning and assignment in detail will be required.

j. Normal medical and general supply procedures will be inadequate for *at least* 24 hours. Prior planning for the procurement of additional supplies and equipment, including an improvised small central medical supply area, will be required.

k. A central area under control of a key official must be planned. This is necessary to control recruited and volunteer civilian personnel to augment the normal hospital strength.

l. Emergency casualty-handling teams and equipment may be required both at and away from the hospital site. Wherever possible such teams should be formed with personnel from sources other than the hospital complement. Using hospital personnel for this purpose will operate to reduce the capability of the facility.

m. Radiation hazards may be serious. This will require appropriate radiologic safety measures.

A typical emergency operations plan for an Army hospital will consist of the basic plan and approximately 20 annexes, one for each subordinate unit or activity in the organization of the hospital. Each annex will contain appropriate implementing procedures relative to the functions and the general responsibilities of each activity of the hospital during the emergency. It should contain specific information such as additional space requirements, coordination with other elements of the hospital, and assistance to be provided to the professional services and departments. It should clearly state the duties of each individual assigned to the activity—where he reports, what he is expected to do, and similar items.

The outline containing guidance to hospital commanders highlights the problem areas considered to be of major importance and indicates some of the appropriate emergency functions. Rather than showing the functions of all hospital activities, I have selected a few which are representative of the others:

a. *Medical Service*

(1) Designation of wards for communicable diseases.

(2) Establishment of strict preventive medicine measures throughout the installation and liaison with local public health agencies.

(3) Patient flow and control.

b. *Surgical Service*

(1) Early and continuing resuscitation, where required.

(2) Designation of sorting, shock, preoperative and post-operative wards or areas.

(3) Emergency equipment and sites for additional and/or alternate operation rooms.

(4) Patient flow and control.

c. *Neuropsychiatric Service*

(1) Assignment of tasks to neuropsychiatric patients who must be hospitalized but are capable of performing some duties. (Normally mild neuropsychiatric cases will not be admitted to the hospital.).

(2) Patient flow and control.

d. *Pharmacy*

(1) Emergency pharmacy procedures.

(2) Levels of stocks to be maintained.

e. *Nursing Service*

(1) Special staffing instructions during the emergency period.

(2) Use of nurses to augment physician staff.

(3) Patient flow and control.

f. *Radiological Service*

(1) Determination of essential x-ray procedures to be accomplished.

(2) Disposition of x-rays.

(3) Radiologic and monitoring.

g. *Outpatient Service*

(1) Augmenting other services.

(2) First aid needs.

(3) Patient flow and control.

h. *Laboratory and Morgue Activities*

(1) Determination of essential laboratory procedures to be accomplished.

(2) Establishment of emergency blood-bleeding units.

(3) Location of whole blood and plasma reserves.

(4) Identify areas to be used for additional morgue facilities.

(5) Autopsies.

(6) Disposition of remains.

i. *Food Service Division*

(1) Establishment of emergency feeding teams.

(2) Delivery service for key personnel who must remain at duty station.

(3) Specify areas to be used as additional facilities for mass feeding.

(4) Availability of field ranges and other field mess equipment.

(5) Arrangements to be made with local commissaries or other sources for additional food supplies.

(6) Patient flow and control.

j. *Troop Command*

(1) Responsibilities for control of personnel and assignments to specific duties.

(2) Notification of personnel of the existence and scope of the emergency.

(3) Home addresses of hospital duty personnel, military and civilian.

(4) Availability of personnel of attached medical units.

(5) Emergency identification cards for hospital duty personnel.

(6) Emergency housing for duty personnel, civilian and military, required to remain at hospital.

(7) Patient flow and control.

k. *Registrar Division*

(1) Augmentation of Admitting and Disposition Office.

(2) Functions of sorting team(s).

(3) Functions of decontaminating team(s).

(4) Type of emergency medical records to be maintained. (For these purposes the use of the emergency medical tag is authorized.)

(5) Holding facilities for the lightly injured.

(6) Disposition of medical records.

(7) Patient flow and control.

l. *Evacuation*

(1) Availability of motor vehicles for patient evacuation.

(2) Source and mode of transportation, other than motor.

(3) Preparation of patients' records and personal effects for evacuation.

(4) Release of the maximum number of patients from the hospital to their own care.

(5) Early evacuation of ambulatory patients.

(6) Helicopter ports near hospital site.

(7) Patient flow and control.

m. *Supply and Service Division*

(1) Changes to be effected within the hospital supply system.

(2) Conservation and use of supplies and equipment on an emergency basis.

(3) Levels of supplies to be maintained.

(4) Liaison to be effected between the director of supply and supporting depots.

(5) Availability of supplies, including whole blood, through normal channels and local procurement.

(6) Supply of clothing for use of patient personnel utilized during the emergency.

(7) Additional transportation requirements—truck, rail and ambulance.

(8) Patient flow and control.

n. *Engineer Division and Fire Protection*

(1) Emergency water purification and supply.

(2) Fire control measures.

(3) Availability of emergency electrical power supply, to include alternate sources and/or standby equipment.

(4) Emergency maintenance procedures.

(5) Improvising items of equipment required and not immediately available, such as operating tables, messing facilities, etc.

(6) Directional signs for posting by Provost Marshal.

(7) Emergency heating equipment.

(8) Standards of housekeeping during the emergency period.

o. *Signal Communications*

(1) Utilization of messengers in the event of damage to telephone system.

(2) Use of radios.

(3) Improvision of other means of communication.

p. *Laundry*

(1) Schedules for laundry pickup and delivery.

(2) Details for the operation of the laundry on a 24 hour basis.

(3) Laundry service under local contract with commercial sources, where indicated.

(4) Use of emergency mobile laundry equipment, where indicated.

q. *Provost Marshal and Traffic Control*

(1) Establishment of necessary guard posts and assignment of personnel.

(2) Posting of directional signs.

(3) Patient control and control of the idly curious.

(4) Assistance from local civilian police force.

(5) Furnishing of guards to accompany patients upon transfer, where necessary.

(6) Plan of road nets for receiving and evacuation of patients.

(7) Designation of emergency automobile parking area.

r. *Public Information*

(1) Release of information to newspapers and others, as indicated.

(2) Maintaining liaison with the Office of The Surgeon General or appropriate Army Technical Liaison Office.

s. *Voluntary Personnel Office*

(1) Responsibilities for control of voluntary personnel and assignments to specific duties.

(2) Home address of voluntary personnel.

(3) Emergency identification cards for voluntary personnel.

t. *Chaplain and Red Cross*

(1) Patient information to outside individuals or agencies.

(2) Maintain patient locator files.

(3) Normal Red Cross functions.

(4) Normal chaplain functions.

I have purposely repeated "patient flow and control" as a problem area within many of the activities of the hospital. Under the circumstances envisioned, this will, in all probability, be one of the greatest problems which we will have to overcome. *This cannot be overemphasized!* I also want to reemphasize that each annex must specifically state the duties and reporting places of the individuals belonging to that hospital activity.

In summary, I reiterate that individual hospital plans must be designed to mobilize the total *resources* of the hospital to meet the demands of the emergency as it actually exists. Our plan is developed on current organization and is supplemented by a series of annexes which detail the mission of each element of the hospital to facilitate its implementation. Professional and administrative committees are responsible for periodic review and test of the plan. However, the overall responsibility of the commander is in no way diminished.

Proper medical care of mass casualties is a challenge to the medical profession. We can meet that challenge only by prior planning for the expansion of our facilities, and the cooperation of all the hospital personnel working as a cohesive unit toward the common goal.

Organization of "Medical Holding Units"*

By

COLONEL THOMAS N. PAGE, MC, USA†

THE purpose of this presentation is to discuss the organization of Army medical holding uits, and also the part that such a unit will play in a situation dealing with a multitude of casualties.

A conventional medical holding unit may be defined as a unit in the theater of operations tailored to provide on-and-off loading facilities and continuation of sorting and treatment at railroads, airheads, and ports. Patients pass through these facilities during the process of evacuation from other Army medical units on their way to definitive treatment facilities in the Communications Zone or to the continental United States. When there is a delay in movement of patients, the unit is capable of continuing treatment and providing for the required comfort for those remaining.

Although other Army medical service units, such as separate collecting or clearing companies, may perform the medical holding function, the Medical Holding Company is the only unit organized for this specific mission. It has sufficient equipment to accommodate 300 patients, or is capable of being divided into three holding sections, each operating as a separate detachment with a capacity of 100 patients.

Under normal conditions the Medical Holding Company could hold patients up to 72 hours. Under unusual conditions, they would hold patients for as long as is necessary within the professional capabilities of the staff, the medical equipment and supplies on hand, and the evacuation facilities available.

The medical holding function plays an important part in a situation resulting in mass casualties. It should, however, be brought out at this point that *all* medical treatment facilities perform the medical holding function to a degree. The extent of the medical holding that such units provide is naturally contingent on the situation at hand, and the resources available to the medical facility.

One of the chief differences between nuclear warfare and conventional warfare is the suddenness and the magnitude of the event, and the almost simultaneous occurrence of a very large number of casualties. In the event of a nuclear attack on the United States, it follows that a state of war will be declared immediately. Under these conditions, the Army Medical Service will utilize its resources to continue its military mission and will cooperate with Civil Defense agencies to the extent directed by appropriate authority. It is not difficult to recognize that the sorting and holding of casualties, before (and I emphasize the word BEFORE) and after they receive medical treatment, is necessary not only from the professional standpoint, but also from the standpoint of the orderly requirement of doing "first things first." For example, it is illogical to spend valuable professional time treating a casualty with a minor injury when another casualty will die if treatment and hospitalization is not given within a short time. On the other hand, it may be just as illogical to spend a lot of professional time on the casualty who will obviously die, irrespective of the treatment received. Also, casualties requiring further treatment and hospitalization will be taken to appropriately located transfer points where holding units are established to receive and evacuate them. Here the sick and the wounded are sorted, and either evacuated immediately or held in order to permit the more serious cases to leave on the first available transportation.

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Under the conditions which we visualize, it will undoubtedly be necessary to develop provisional type medical holding units which will be capable of handling greater numbers of casualties than we have ever attempted before. These would be set upon the periphery of the blast area under any shelter available. In the period of confusion and hurried exodus from the damaged area, there will be an influx of both real and imaginative casualties. The resources of all medical treatment facilities will be strained. There is no question that the mission of that facility for providing medical care will be seriously impeded if its resources were utilized for ambulatory non-effectives whose primary requirement will be for food, rest and shelter. Under such conditions the hospital must concentrate on providing "life-saving" type care. It must depend on other medical units to do the intermediate sorting and holding, or "trapping" those patients who can do without professional medical care. The medical holding units fills this requirement.

The mission of the medical holding unit is one of two or both—holding and sorting. *As to sorting,* the Table of Organization and Equipment of the Medical Holding Company offers a very excellent organization to perform these activities. With the nucleus of trained personnel in the company, it could be broken down into seven teams, which appear to be ideally adapted to perform the required functions. Each team would be commanded by either a Medical Corps officer or a Medical Service Corps officer who has been trained in field medicine to the point where injuries and simple fractures can be handled. Each of these teams would have six medically trained enlisted personnel. Litter bearers and other enlisted personnel would be recruited from among other service troops in this vicinity. The idea is that para-medical personnel can be utilized to combat shock, give intravenous injections, and splint fractures. All sorts of emergency measures would be in order. Every non-medical unit in the vicinity would be called upon to give assistance. Vehicles for evacuating casualties may be recruited from the other military services in the vicinity and from civilian sources.

As to the holding function, many casualties will be of a type who do not require immediate, life-saving medical attention. Treatment in those cases may be deferred until they can be transferred to a more suitable medical treatment facility. In any event, such casualties must not be permitted to enter the hospital system at this time. The majority of such patients can be attended to and supervised by non-professional personnel. It is obvious that circumstances will dictate the operation of very meager and almost "bread-line" type facilities for these ambulatory non-effectives. We hesitate to think in terms of such austere medical facilities, even under these extreme conditions. But we must be realistic! Such a holding function is a necessity wherever large numbers of casualties are processed. When a hospital facility is employed under these conditions, the holding function should be an adjunct to the hospital in order that the maximum resources of the hospital can be devoted to rendering professional care, and not be dissipated in sorting out minor conditions, housing ambulatory non-effectives, or holding others for evacuation.

The plan for medical holding and evacuation will be dependent on the existing medical evacuation facilities, and the actual and the estimated number of incoming casualties. The decision as to who is evacuated by the transportation at hand, and who must necessarily remain behind, either for later evacuation facilities, or for the purpose of receiving medical treatment, requires mature judgment and should not be left to untrained individuals. Transportation facilities will be strained to the maximum and will be at a premium. It should be utilized wisely. Since transportation facilities are the life-line, so to speak, in order for the medical holding unit to perform its mission, the holding unit commander must maintain frequent contact with the appropriate headquarters to insure that adequate transportation means are made available. In all likelihood, a nu-

clear blast will cause communications to be disrupted. In that event, it should be strongly emphasized that when contact with the headquarters has been lost or communications disrupted, it is most important that every effort be made to re-establish communications and relieve the medical unit of its casualties.

The Army Medical Service has had considerable experience in improvising medical holding units to cope with mass casualties.

Those of you who remember the early days of the Korean conflict will recall that sorting and holding was extremely important at Pusan and later at Pyongyang in late November and December 1950, and again at Hungnam. Large numbers of patients, including ambulatory non-effectives, were held in the provisional medical holding units prior to medical evacuation by rail, ship and air to Army hospitals in South Korea and Japan, or return to their duty organizations. The medical holding facility at Yon-po airfield, south of Hungnam, in early December 1950 was typical of the type of medical unit which is set up under those conditions. A large holding unit was improvised specifically for the purpose of receiving, holding and evacuating patients from divisional medical units of the Xth Corps. All available Medical Corps officers were used to sort patients. Seriously wounded patients were taken to either a Mobile Army Surgical Hospital (1st MASH) or an evacuation hospital (121st) immediately after being received from the forward areas. Some were returned to duty after adequate food and rest. All others, including those who were treated at the nearby Mobile Army Surgical Hospital and evacuation hospital, and requiring further definitive treatment were medically evacuated by air to Japan for distribution to Army hospitals. During the period of two weeks, the facilities of this holding unit accommodated over 500 patients per day. There is no doubt that it could have accommodated far more casualties. This one incident is illustrative of merely one experience of sorting and holding casualties during conventional warfare. Some of you here may recall other similar experiences, either in the Korean conflict, or in World War II. However, we must remember that the use of nuclear weapons will cause casualties in considerably greater numbers, and our planning to cope with them must be geared accordingly. The medical holding function will play a highly important role in the rendering of maximum care to those requiring medical attention.

I have presented to you an abbreviated discussion of merely one facet of the overall responsibility of the Army Medical Service in the management of mass casualties. There is no question that through the optimum application of the medical means available, we could extend the capability of our medical facilities for the holding, sorting and evacuation of even greater numbers of casualties in the event of a nuclear disaster.

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Summary: Organization for the Management of Mass Casualties*

By

COLONEL R. L. HULLINGHORST, MC, USA†

AS THE past few days have revealed, the medical professions now face the greatest challenge of all time—the management of mass casualties. As Military Surgeons we carry a large responsibility for the definition of problems and for the development of plans in this field.

This morning the speakers accepted the acute shortage of physicians in such an emergency. They realistically suggested ways in which personnel of the various services could be used individually to best advantage. This afternoon we progressed to further considerations of the preparation and use of this total manpower.

Colonel Sanders has pointed out the immense training problems associated with:

a. The training of all physicians in the principles of combat surgery, and in the necessary expansion of their supervisory responsibility.

b. The training of the allied professions in their role of supplementing the physician.

c. The training of nurses as surgical assistants, anesthetists, and medical therapists.

d. The training of medical technicians to advanced levels of skill and judgment.

e. The training of other medical service personnel in roles of advanced responsibility.

f. Training all personnel in the basic essentials of first-aid. After all, unless the individual soldier or civilian can save his own life, or that of a buddy, neighbor, or member of his family, many injuries will prove fatal long before medical care becomes available.

But mere training of individuals is not enough. The individuals must be welded into teams and units. Each member of the team or unit must know what is expected of him and of his unit. Colonels Goldstein, Moore, and Page have given us some suggestions on just what teams and units are required.

Obviously, some type of aid station must be moved as close as possible to the area of disaster. Unless this forward unit supplies emergency medical care and intelligent sorting, our hospitals will receive overpowering numbers of minimal injuries, plus those who, unable to withstand movement, died enroute. The sorting unit proposed consists of three teams, each team being composed of one physician and eight technicians. Ideally, these would best be provided from individuals not assigned to a hospital unit. Realistically, the supporting hospital might be required to spawn them.

Colonel Moore has briefly but comprehensively touched on the many problems that face the hospital commander. The establishment of a Professional Disaster Committee and an Administrative Disaster Committee to prepare, test, review and improve the hospital disaster plan is an obvious requirement. He called attention to the necessity of a prepared plan, and a thorough trial of the plan. He outlined the requirement for: (a) immediate re-evaluation of all patients, retaining only those who cannot be released or recruited to positions of assistance to the hospital staff, (b) readiness to expand to adjacent structures, (c) provision for external and internal communication and control, (d) assignment of key responsibilities to alternates, and (e) expansion of administrative and logistic facilities to support and balance the increased requirements of the busy professional staff.

Colonel Page has directed our attention

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to another important important unit which tends to be overlooked in our preoccupation with mass trauma. Even a fully staffed, trained, and prepared hospital can receive only so many patients in a limited period of time. Should the rescue efforts and the energy of our sorting stations exceed expectations, some medical facility may need to hold and support patients awaiting surgery. In fact all patients not requiring immediate surgical care such as those with symptomatic radiation illness, or those who are medical emergencies, could probably be best managed and treated in a non-surgical facility. Later, many of the patients who had received initial surgical care could well be removed from the overloaded surgical hospital, gradually replacing in the holding unit those whose priority was for delayed treatment. As some order began to emerge in the overall medical picture, these flexible holding units might even return to their more customary role of preparing patients for evacuation.

Now in all of today's discussions there has been no specific mention of the SIZE of the hospital units we are considering. This may have been deliberate, but let me in my summarizing role bring it up. It is a problem that requires serious attention and consideration. Should we think and plan in terms of 200 bed hospitals or 5,000 bed plants? The 200 bed provisional hospital has many advantages. It is mobile, quickly established, and easily adaptable to our usual city or country school structures. Their operation on around the clock basis requires a higher proportion of surgeons to patients than can be reasonably expected. When we consider the problems of rescue and of fall-out hazards, however, speedy establishment of hospitals may not be too necessary or desirable. Larger surgical units may be more preferable and realistic. Obviously, they have neither the mobility or flexibility of the smaller hospital. Furthermore, they require structures such as a government institution, a college or university, or a military installation. However, the larger hospital may be opened initially on a reduced scale, growing over the hours and days to meet the medical load. Such a unit would definitely allow more realistic and efficient use of critical skills. Once established, it could continue to function beyond the immediate post-impact period—in fact until the bulk of the medical problem had been met and solved.

As has been pointed out today, the scarcity of medical skills is of prime importance in any such situation. Basically, our decision must be made in answer to whether we expect a nationwide medical load of one million, or ten million patients.

In closing this summary, I would like to mention what must be apparent to all. Some questions have an all-too-obvious answer—the need for planning, for preparation, for training, and for trial. Many questions remain undetermined, undecided, or unanswered.

Discussion of Organization for the Management of Mass Casualties*

By

BRIG. GEN. HAROLD G. SCHEIE, MC, USAR†

ORGANIZATION is the key to success or failure in the management of mass casualties. The imperative nature of meticulous organization has been mentioned in passing by several of the previous speakers, and especially by Dr. Berry. He noted that the effectiveness of the handling of previous disasters in this country, for example, as long ago as the San Francisco earthquake, and as recently as the Wooster calamity, was dependent upon how well available knowledge and supplies were utilized and discipline maintained, all of which depends upon proper organization.

The necessity for effective preparation and organization on the part of both the military and civilian population is obvious with the magnitude of the problems presented by atomic warfare. We have ample knowledge of the handling of large numbers of conventional type casualties gained through experience in previous wars by the military and from the study of past civilian disasters. Knowledge has also been gained through the trials of other nations exposed to all-out bombing. We are accumulating expert information on the specific problems of the treatment of radiation injuries as a result of extensive research programs of military medicine and others. Our country is favored by rich resources and supplies. The effect of utilization under the adverse circumstances of all-out radiation war is necessary. Preparative measures must involve attention to the most meticulous details. We have heard that following an atom bomb explosion, improvisation will be the order of the day. Care must be taken that it be intelligent and purposeful. Not only every doctor will be a surgeon for a time, but so will every citizen. Tourniquets, splints and artificial respiration will be applied as life-saving measures by relatives, buddies and neighbors. Proper education can insure a knowledge of first aid and the maintenance of some degree of discipine. In our country, in the past, every citizen as a result of necessity, has known something about firearms, and today knows something of the intricacies of the automobile. There is no reason why the principles of first aid, which involves survival, should not be part of our daily life. This has been touched upon by Colonel Saunders who suggested instruction in schools. I would like to suggest the use of nation wide television for this type of instruction to mass audiences.

In addition to the organization and discipline applied to the individual, we must have over-all organization and coordination between communities, cities and states. Immediate responsibility for survival must be placed at local level where only primitive means for medical care may remain. Hospitals, medical personnel and supplies may be decimated. It is difficult to imagine, for example, atomic bombing of Philadelphia in which most of the hospitals and the staffs would not be annihilated. In addition to local preparations involving first aid, evacuation, pre-assigned duties and pre-assigned hospital areas, the bombed out city must depend upon medical aid to migrate from the periphery. This must be done under difficulties of communication and transportation. A regulating office to care for the proper flow of patients to temporary hospitals must be established. Little doubt exists that such over-all organization must proceed along lines already proved of great value and

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thoroughly tested by the military-medical establishment. Under conditions of martial law which will probably be imposed very promptly following mass disaster, much of the responsibility for meeting the emergency will revert to the military, whether or not this might be of their choosing. Civilian chaos, which would mean military defeat, must be prevented. There will be little distinction between the military and civilians and certainly civilian choas will mean military defeat. I therefore strongly urge the closest possible coordination between civilian defense planning and military organizational efforts for the management of mass casualties anticipated in atomic warfare. One must supplement the other and organization must be such that the plans of civilian defense can quickly be integrated with those of the military.

EDITORIALS

Time for Action

THE Armed Forces Library has been in the position of the well known Flanigan hand car—"off again, on again." For years we have been hearing about its new building and its moving to another site in Washington. But nothing happens. At one time we heard about the Library moving to the Walter Reed Army Medical Center, later about construction at the National Naval Medical Center. Recently we have the report of the Hoover Commission advising that the Library be removed from the jurisdiction of the Defense Department entirely and placed under the Smithsonian Institute. But nothing happens.

Were the possessions of this library in the form of a yellow metal they would have been deposited long ago in the caves of Kentucky. Since the shelves of the library contain books, *many of which cannot be replaced,* the value is not as readily realized as that of the precious metal. So this fine collection of medical history continues to be housed in outdated fire trap buildings.

Years ago (1836) a far sighted Army physician, Surgeon General Joseph Lovell, realized the great contribution that could be made to medicine by preserving some of the fine old works and adding to the collection those of the modern era of medicine. That was over a hundred years ago and the contributions added since Billings had his vision of this medical library have been many. This collection is now the greatest of its kind in the world.

Long known as the Surgeon General's Library, then as the Army Medical Library, and lately as the Armed Forces Medical Library, this institution will pass over to other hands. Whatever division of the government the Library is put under that division must assume a great responsibility for preserving this valuable collection of medical material and adding to it. The responsibility is great not only to the United States but to the world.

Two things should be done *now*—take positive action in selecting the recipient division of the government since the Armed Forces are to assume no further control, and get busy to house in a modern building this very valuable collection of medical literature, some of which antedates the material in our National Archives Building, an imposing building in Washington.

Yes, the time for action is *now.* We have already delayed too long in providing a National Medical Library Building.

Armed Forces Day

MAY 19 this year will be observed by the military services as ARMED FORCES DAY. This is the sixth year of such an observance, by our military forces, the first one being in 1950. The theme this year will be the same as adopted in 1953 and carried through 1954 and 1955 —*Power for Peace.* Of course, there will be "open house" at many military installations.

Preparedness to defend and to retaliate when attacked is as essential in these days as it ever was in the past. Too frequently we have left our guard down because of the smiles and deception of some foreign diplomats who carried this mask of friendship but behind it had a brain full of connivance and intrigue.

The guard must be kept up. We are reminded of a passage in the Bible (Nehemiah, 4th chapter): "Half of my servants wrought in the work, and the other half of them held both the spears, the shields, and the bows, and the habergeons; and the rulers were be-

hind all the house of Judah. They which builded on the wall, and they that bare burdens, with those that laded, every one with one of his hands wrought in the work, and with the other hand held a weapon. For the builders, every one had his sword girded by his side and so builded."

While we are determined to build a nation of four freedoms there are other nations as determined that we shall not build such a structure. So we must keep one hand on the sword and one hand on the building, though we would prefer to have two hands on the constructive work. Costly as the Power for Peace program may be, it is a necessary measure because liberty once lost will be regained only with much more cost in money and bloodshed.

On Armed Forces Day we will view machines of all kinds but these machines are only the power that America intends to use to keep peace, but not peace at any price.

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VIET NAM OFFICERS AT ARMY MEDICAL SERVICE SCHOOL, BROOKE ARMY MEDICAL CENTER, FORT SAM HOUSTON, TEXAS

U. S. Army Photo

(L to R) *Seated,* Lt. Col. Pham Van Trien, Deputy Chief of Health Service, Viet Nam Army; Brig. Gen. Elbert DeCoursey, Commandant Army Med. Serv. School; Major Pham Van Hat. *Standing,* Maj. Hoang Van Duc, Lt. Nguyen Guang Tuong, Lt. Nguyen Tri Vang, Capt. Nguyen Van Tho, Capt. Nguyen Van Lust, Lt. Nguyen Van Le, Capt. Tu Duong, and Maj. Nguyen Huu Thu.

Around the World

By

CLAUDIUS F. MAYER, M.D.

VIRGIN ISLANDS have been plagued with a *high rate of syphilis* and other venereal disease. A serological survey made a few years ago, included just about one half of the population (approx. 14,000). About 11% of the people were found luetic. Year after year, new cases of syphilis are detected at the few outpatient clinics at the rate of 7 to 10 per thousand inhabitants. Lack of proper therapeutic facilities is blamed for the growing syphilization of natives. (N.B. in the U. S., 150,026 new cases of syphilis were diagnosed in 1953. From this total, our yearly increment in syphilitics can be estimated at 0.948 per thousand.)

From November 13 to 20, 1955, Venezuela had been the host of the third *American Congress on Industrial Medicine.* The industrial physicians met in Caracas, with the participation of all American states. They considered pathology pertaining to petroleum, discussed industrial accidents in the social security system, suggested means for professional rehabilitation of the workers, lectured on manganese poisoning, on vision and illumination in industrial establishments, and proposed measures for the medico-social protection of rural workers.

It is not widely known that Brazil's new president, Dr. Juscelin Kubitschek, who was inaugurated in January, is a physician by profession. He descended from Czechoslovak ancestors who had settled on South-American soil two generations ago. The new physician-president represents ideas of the social democratic and the labor parties, and he is considered the heir to the politics of Senhor Vargas.

This month (April, 1956) the command of the *British Army Medical Service* is taken over by a *new Director General.* He is Maj. Gen. W. A. D. Drummond (born 1901), a South-African by birth, who is succeeding Lt. Gen. Sir Frederick Harris. Among his problems he finds the task to correlate the military medical services with the British type of nationalized medicine.

The *National Health Service* completely *changed the type of medical practice* in Great Britain and throughout the British Empire. While the public is able, under this service, to get medical attention free, and the doctor also is sure of his income on a capitation basis, there are many disadvantages of the system. For example, the doctor-patient relationship is gradually lost, while the large number of patients in the doctor's office and hospital wards leads to a failure to make a diagnosis, which results in more and more symptomatic treatment. The disadvantages of the system to the physician are numerous. One of the greatest is that young doctors are drafted into grooves from which they cannot move without reverting to the lowest grade and starting again in a new channel should they wish to change to another specialty.

Another result of the British National Health Service has been the growth of a large force of hospital administrators. This complaint was recently aired in a letter from England (by J. Lister). Formerly, the small hospitals were administered by a house governor, a clerk, and a lay committee. Now, the same institution has multiplied its staff many times. Form filling, paying salaries to honorary staff members, attending a new crop of committees, and reporting to higher authority makes this staff-multiplication essential.

The desire for company brought the *sufferers from asthma into an association* in England. The group was originally founded in Manchester, the city of fog and smog, in 1953, for the promotion of research on the prevention and treatment of asthma, for the establishment of information centers and clinics, and the support of movements for

prevention of air pollution. By the way! Asthmologists of the world had also felt the urge to unite. They formed the *International Association of Asthmology,* shortly "Interasma." All nations will be represented in the new medical association which will publish a magazine and will hold its first meeting this year.

The *"prophylactic packets" of the British Armed Forces,* issued for the prevention of venereal disease, are the target of criticism lately. The National Association for Moral and Social Hygiene took offense on the preventive measure, and demanded that the custom should be abolished. In the Association's opinion, the presence of these packets encourages promiscuity and increases the chances of the spread of VD. The attempt of that Association to suppress the packets is plain "intolerance" in the eyes of others. "One would never withhold quinine in a malarial area," as a letter-writer expressed himself to the Editor of a medical journal.

A *"Memorandum of Evidence" on homosexuality and prostitution* was recently published by the British Medical Association. It was prepared for the guidance of a special Departmental Committee which was set up by the government to consider the law, practice and treatment of homosexuality and prostitution. Though both vices are essentially social rather than medical problems, every physician would gain much insight into the medical aspect of these psychopathological deviations by reading the memorandum (to be found in the Dec. 17, 1955, Supplement of the British Medical Journal).

In *Israeli, afforestation* serves various good purposes. Several forests were planted as memorials, such as the Herzl Forest that started in 1904, or the five so-called Freedom Forests in memory of Jewish allied soldiers who fell. The trees, planted on now barren hills, protect the land against soil erosion; they also help the reclamation of desert areas. Forestation will change the climate of the country for the good of the people. Afforestation is also a valuable means of draining swampy land, and of depriving the malaria mosquitoes of breeding grounds. Thus, the Vale of Jezreel, a former marsh, was made habitable by plantation of eucalyptus trees.

Greece is not immune to sickling of the red cells. The phenomenon was first seen there in 1939-40 in an isolated village of the Sparta District. Since then, other foci of sickling were founded in other parts of the country, in Thebes for instance, but chiefly among the people living in Chalkidiki, especially in its southern area where sickling ranges up to 14% of the population. *Sickling in Greece* is attributed to mutation of the gene and to the influence of malnutrition, malaria, and intermarriage during the last few centuries. (Let's recall that sickling was first discovered in 1910 among the American Negroes, and for some time it was thought to be an exclusively racial mark. Its presence in white people cannot be considered as a proof of Negro admixture.)

Several strange diseases have been observed lately in different parts of the world. *In Jamaica,* for instance, children and adults sometimes suffer from a disease marked by sudden abdominal ache, enlarged liver, fluid in the peritoneal cavity, and slight edema about the ankles. It is called *veno-occlusive disease of the liver* since subintimal thickening and narrowing of the lumen of branches of the hepatic vein is the most outstanding feature in tissue biopsy. Malnutrition or undernutrition is the background to the disease. Most of the sick are *habitual drinkers of "bush tea"* varieties, infusions of various herbs, seed and roots such as donkeyweed (Stylosanthes hamata), dandelion seeds (Cassia ligustrina), cerasee (Momordica), Jack-in-the-bush (Eupatorium), etc.

Another recent strange disease is *the mystery disease of India.* It was first observed on May 4, 1954, and after its birthplace it was named *Jamshedpur fever.* It attacks children and young adults, many of whom die. Jamshedpur is a rather clean city in India, with a population of a quarter of a million, who are chiefly industrial workers and followers of a higher than customary standard of personal hygiene. The disease

sets in suddenly, with high fever and under the general symptoms of a virus encephalitis. It is spreading to other Hindu cities, to the great concern of the Virus Research Center in Poona, India.

According to certain WHO statistics, the *worst shortage of physicians* exists in the following ten countries: Ethiopia (1 physician to 164,835 people, or 91 medical persons to treat 15 million people); Nepal and Buthan (1:146,000); Cambodia (1:89,787); Afghanistan (1:70,000); Indonesia (1:68,205); Viet Nam (1:61,914); Nigeria (1:58,939); Sudan (1:50,690); Arabian Peninsula (1:40,000); and Pakistan (1:36,073). In North America, the most striking shortage is found in Haiti (1:10,756), while in South America it is Peru which has the fewest physicians (1:4,733). Among the European countries, Albania (1:12,500), Bulgaria (1:4,139), and Jugoslavia (1:3,365) are in the worst position concerning medical aid.

The *highest per-capita rate of physicians* is to be found in Israeli (1:431), Austria (1:646), USSR (1:758), Germany (1:760), USA (1:777), New Zealand (1:797), Iceland (1:829), Italy (1:841), Hungary (1:842), Norway (1:958), Hawaii (1:970), Denmark (1:974), Canada (1:989), and Switzerland (1:999). The rate of shortage in physicians also varies according to medical specialties.

International statistics clearly show that more and *more people die from cancer of the respiratory system.* There is also a growing percentage of all cancer deaths, when the mortality rates of the past five years are compared. For Scotland, for instance, a 36% rise in mortality from respiratory cancer is recorded (1949-52 period). Similar rise was noted in the federal Republic of Germany (40% for men), England (31%), Denmark (49%), Ireland (47%), Italy (45%), Finland (30%), France (30%), Norway (32%), Netherlands (24%), Switzerland (28%), USA (21%), Japan (68%), Australia (25%), New Zealand (46%).

Among the great *international problems of cancerology* there are such as the geological factors of endemic cancer, and the carcinogenic properties of some food additives. English physicians are very much concerned with the *carcinogenic nature of smoke polluting the atmosphere* of towns. It was found, e.g., that the 3:4-benzpyrene, which is always present in soot, occurs in London in a concentration of about 5 micrograms in 100 cubic meters of air. Since the "average man" inhales about 20 cubic meters of air in 24 hours, his daily intake of benzpyrene would be 0.5 microgram. From various experiments it is known that this amount is about the minimal dose of benzpyrene to produce sarcoma in the mouse. In foggy weather, the benzpyrene content of the air is 8 to 11 times higher. One wonders whether the present higher incidence of lung cancer be due to the smoke produced by the increased automotive vehicular traffic rather than to the smoking of tobacco.

In the opinion of a Hindu physician, *prosperity and obesity walk hand in hand.* Indeed, as he thinks, fatness provides the best volumetric index of one's worldly progress—first, the buttocks enlarge and round; next, the belly protrudes; then, the chin multiplies; and, at the end, the neck is getting fat and tough. *Automassage* is therefore advocated by our Hindu confrere to undo the damages of good fortune.

A Surgeon-Commander of the British Navy studied the *works of Shakespeare,* and from them he collected some *interesting medical and sanitary allusions* which he printed in several issues of a royal naval medical journal. Among others, he also referred to the *Elizabethan lavatory,* the "jakes" or Ajax. This piece of "culture" had been facetiously described in 1596 by Sir John Harrington in his "An Anatomy of the Metamorphosed Ajax," etc. The contemporary diagram leaves no doubt that Ajax was not only a hero in the Iliad but also the seat in the outhouse, with an anterior notch cut out of the otherwise round seat, or—as Sir John put it—"a seat, with a peak devant, for elbow room."

There has always been some confusion and misunderstanding when medical reports and

papers refer to such multiple parts of the body as digits, fingers and toes. An English colleague proposed the following *designations for toes:* "big, index, middle, ring (sic!), and little." Angered by such nonsense, another doctor, of the town of Banbury, countersuggested the other day that there should not be any room left for doubt in the mind of English-speaking people, regardless of their age, if these same toes would be denominated as follow: "Market, home, roast-beef, none, and wee-wee-wee" . . . . *Multa Paucis!*

406TH MEDICAL GENERAL LABORATORY, CAMP ZAMA, JAPAN

406th Med. Lab. Photo

Pictured above are the buildings of the U. S. Army's principal medical laboratory and disease research center in the Far East. The Laboratory under the command of Colonel Joe M. Blumberg, recently moved from Tokyo to Camp Zama.

SUSTAINING MEMBERS

It is a privilege to list the firms who have joined The Association of Military Surgeons as Sustaining Members. We gratefully acknowledge their support.

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ASSOCIATION NOTES

Timely items of general interest are accepted for these columns. Deadline is 3rd of month preceding month of issue.

Department of Defense

Ass't. Secretary (Health & Medical)—Hon. Frank B. Berry, M.D.

Deputy Ass't Sec'y.—Hon. Edw. H. Cushing, M. D.

HR 9429

The above number refers to "A Bill to provide medical care for dependents of members of the uniformed services, and for other purposes" introduced in the House of Representatives by Mr. Kilday, from the Committee on Armed Services, February 20, 1956.

The term "uniformed services" is defined as the Army, Navy, Air Force, Marine Corps, Coast Guard, Geodetic Survey, and the Commissioned Corps of the Public Health Service, and the members of those services are those on active duty for more than thirty days.

The term "retired member of a uniformed service" means a member or former member of a uniformed service who is entitled to as a result of service in the uniformed service, other than a member or former member entitled to retired or retirement pay under title III of the Army and Air Force Vitalization and Retirement Equalization Act of 1948.

The term "dependent" is defined in the bill but the usual interpretation for this can be accepted without quoting the words of the Bill.

Provision is made for the joint utilization of government medical facilities. There would be an established uniform subsistence rate. An outpatient charge to curb excessive medical demands is included.

The Bill provides for diagnosis, treatment of acute medical and surgical conditions, immunizations, maternity and infant care, and emergency dental care.

The payment of the first $25 for hospitalization will be borne by the dependent, and thereafter provisions for an insurance to cover medical expenses, paid by the government, is a provision. Well, these are some of the highlights of the Bill. We shall see what happens when it gets to the floors of the House and the Senate.

SUPPLY MANAGEMENT

The Secretary of Defense has adopted the "single manager plan" for the supply of the military forces. Mr. Wilson said its "Clear purpose . . . is to promote increased economies in the utilization of manpower, material, and services."

In effect this means that all materials used by the military establishment will be grouped and the responsibility for certain groups will devolve on one of the three services, Army, Navy, or Air Force.

Food and clothing has become the responsibility of the Army; medical and dental supplies along with petroleum will be the responsibility of the Navy. It is interesting to note that for some years now the medical services have had a joint procurement agency which has been mutually beneficial. There has really been unification in this field. It is hoped that the already well functioning agency will not be disrupted by the recent directive.

HEART DISEASE COURSE

A postgraduate course on diseases of the heart will be held at the Armed Forces In-

stitute of Pathology, Walter Reed Army Medical Center, Washington, D.C., from May 14-17.

The course will enable the physicians to acquire a better understanding of the pathology of heart disease, and is designed for the clinician as well as the pathologist. Many noted physicians, both military and civilians, are on the program as instructors.

It is expected that 425 doctors will attend the course which is open to civilians as well as military personnel. Civilian physicians who desire to attend may apply to the Director, Armed Forces Institute of Pathology, Washington 25, D.C. Military physicians should apply through channels.

FIRST-AID MANIKIN

Mark II manikins for use in teaching first-aid procedures have been ordered by the Army, Navy, and Air Force for their training programs.

A very realistic approach to first-aid problems can be had because of the circulation of a liquid resembling blood and the number of rubber moulds resembling wounds.

The Mark II manikin was developed jointly by Mr. William C. Young, Exhibits Director, Naval Medical School; Captain John V. Niiranen, DC, USN, Naval Dental School; and Mr. Thomas Haynes of Rogay Models, Washington, D.C.

AVIATION PATHOLOGY MEETING

This group will collect information on pathology in relation to aviation.

Committee on Aviation Pathology, Febru-

The Armed Forces Institute of Pathology was the site of the first formal meeting of the Department of Defense sponsored Joint ary 7.

Army

Surgeon General—MAJ. GEN. SILAS B. HAYS

Deputy Surg. Gen.—MAJ. GEN. JAMES P. COONEY

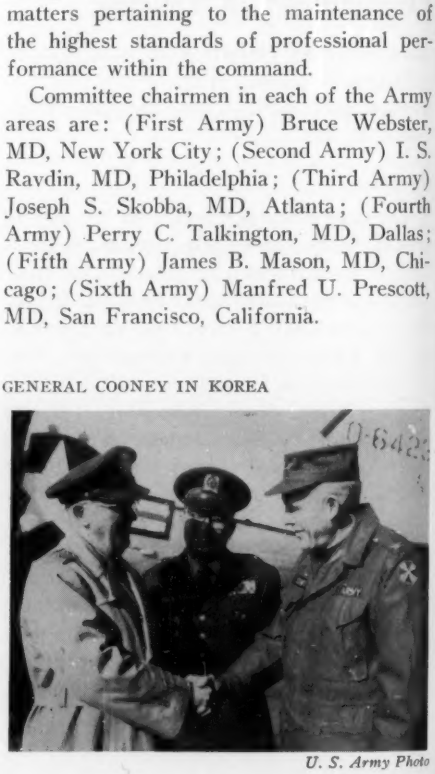
AREA CONSULTANT COMMITTEES

Six committees on civilian consultants to the Army Surgeons in the zone of the interior have been formed by The Surgeon General, in cooperation with the Society of Medical Consultants to the Armed Forces.

The committees, which have a membership of at least three outstanding physicians in the area, represent the fields of medicine, surgery, and neuropsychiatry. They will be called upon to assist the Army Surgeon in the professional appraisal, procurement, and appointment of professional consultants to local medical installations; in the supervision of civilian medical consultation in Class I Army medical installations; and in other matters pertaining to the maintenance of the highest standards of professional performance within the command.

Committee chairmen in each of the Army areas are: (First Army) Bruce Webster, MD, New York City; (Second Army) I. S. Ravdin, MD, Philadelphia; (Third Army) Joseph S. Skobba, MD, Atlanta; (Fourth Army) Perry C. Talkington, MD, Dallas; (Fifth Army) James B. Mason, MD, Chicago; (Sixth Army) Manfred U. Prescott, MD, San Francisco, California.

GENERAL COONEY IN KOREA



U. S. Army Photo

General Cooney, Deputy Surgeon General of the Army (left) on a tour of medical installations in Korea is greeted by Colonel Smith, (right) Surgeon, Eighth Army, and Brig. General Shin Hak Chin (center), Surgeon General of the Republic of Korea Army.

PROMOTIONS

All Army physicians and dentists in the grade of first lieutenant who have at least one year of professional experience will be advanced to the temporary grade of captain.

This announcement by General Hays will affect an estimated 1,100 medical and 500 dental first lieutenants.

Starting this month young doctors and dentists entering the Army will receive initial grades of captain if they have a year or more of professional experience. With the exception of military interns, who serve as first lieutenants, the lowest grade in the Army Medical Corps will be that of Captain.

ASSIGNMENTS IN SGO

Major Marjorie J. Lindau, ANC, who has been on duty in Europe will succeed Major Ida Graham Price as Chief of the Nursing Education Section in the Office of the Surgeon General. Her assignment will be effective in May.

Lt. Col. Carrie E. Barrett, ANC, has been assigned as Assistant Chief of the Army Nurse Corps Assignment Section, Office of the Surgeon General. She replaced Maj. Harriet Dawley, ANC, who was assigned to Europe.

Lt. Colonel Raymond Coward, of the Judge Advocate General's Corps, has been made Chief of the Legal Office of the Office of the Surgeon General. Colonel Coward received his law training at the University of Iowa. He has been admitted to practice before the Supreme Court of the United States and the U. S. Court of Military Appeals.

NURSES' CONFERENCE

The Chief Nurses' Conference held annually in the office of the Surgeon General was held April 2-6. The central theme of the conference was "In-service Education for Nursing Service Personnel."

Those attending the conference were Colonel Inez Haynes, Chief of the Army Nurse Corps, nursing service chiefs of the Army named hospitals, officers responsible for the nursing service in each of the six Army areas, and the chiefs of the nurse faculties at the Army Medical Service School and the Medical Training Center of Fort Sam Houston, Texas.

WRAMC NEWS ITEMS

Colonel O. F. Goriup, MSC, has been named Chief of the Operations and Training Division at the Walter Reed Army Medical Center. Colonel Goriup recently returned to Washington from Japan. From 1947 to 1951 he was the first Chief of the newly organized Medical Service Corps of the Army.

NURSING SERVICE WRAH

Major Ruth P. Taylor has succeeded Lt. Colonel Carrie E. Barrett in the position of Assistant Chief of the Nursing Service at Walter Reed Army Hospital.

KELLER LECTURE

The William L. Keller Lecture was given by Dr. Howard C. Naffziger, a world-renowned neurosurgeon, at the Walter Reed Army Medical Center on March 15. The speaker chose as his subject "Brain Surgery Through the Ages."

Colonel Keller, a retired Army surgeon, was a pioneer in chest surgery. He is well known for devising a splint used in transporting patients with leg fractures. A life time consultant to Walter Reed Army Medical Center, Colonel Keller lives at 2930 Foxhall Road, N.W., Washington, D.C.

CHAPLAINS WEAR WHITE COATS

Walter Reed Army Hospital chaplains are now wearing white coats as an outergarment instead of the conventional blouse. Officially these coats are known as the *Chaplain's Visitation Coat.*

Coats of the Protestant and Catholic faiths differ from the Jewish garment in that they wear a cross over the left pocket while the Rabbis' insignia is the Ten Commandments Tablet.

These coats are also worn by chaplains at the Madigan and Fitzsimons Army Hospitals.

BOOK RECORDINGS

Patients in Tripler Army Hospital can enjoy books read to them by a "mechanical reader." Full length books on records are

U. S. Army Photo

available to those who for some reason are not able to read themselves. Here is shown one of the attendants at the hospital placing one of the recordings on the machine for a bed patient.

PARA-MEDICS DEMONSTRATE

Army Photo

Shown here are para-medics of the 82nd Airborne Division of Fort Bragg, N.C., getting ready to jump and making landings prior to setting up a medical clearing station in a demonstration before students of the Army Medical Service School, Fort Sam Houston, Texas.

Army Photo

BAMC UNIT ACTIVATED

The ninth major component of the Brooke Army Medical Center has been activated as the *Army Field Medical Service Development Unit.* Major General William E. Shambora, the medical center commander has announced that Colonel John H. Taber will command this new unit.

The mission of this new organization is that of "testing Army Medical Service equipment and doctrine in the field."

Colonel Taber prior to his assignment at Brooke Army Medical Center was medical representative on testing Board No. 2 of the Continental Army Command, Fort Knox, Kentucky. He graduated from the Army War College in 1954.

DENTAL TRAINING PROGRAM

Army Photo

(L to R) Capt. Wm. R. Wolfe, Jr.; Maj. Gen. Oscar P. Snyder; Maj. Karl K. Webber; Brig. Gen. James M. Epperly; Capt. Benj. L. Lynch.

Training of enlisted personnel in the Dental Specialists Course was recently discussed at the Brooke Army Medical Center. Maj. General Oscar P. Snyder, Chief of the Army

Dental Corps, and Brig. General James M. Epperly, Director of Dental activities at the Center are shown above discussing matters with a dean and two faculty members from civilian schools of dentistry who are now on active duty at the Center.

Captain Benjamin L. Lynch is Dean in Absentia from Creighton University Dental School, Omaha, Neb.; Major Karl K. Webber, on leave as Acting Director of Operative Dentistry from St. Louis University Dental School, St. Louis, Mo.; Captain William R. Wolfe, Jr., Associate Professor in Oral Medicine, on leave from the University of Louisville School of Dentistry, Louisville, Ky.

MAN OF THE YEAR

Brig. General Elbert DeCoursey, Commandant of the Army Medical Service School, Fort Sam Houston, Texas, has been selected "1955 Man of the Year" by the Phi Beta Pi, national medical fraternity.

General DeCoursey entered the Army Medical Corps in 1928 and chose the field of pathology as his specialty. In this field he has distinguished himself. During World War II he was a member of the Committee for the Investigation of the Atomic Bomb. Later he became Director of the Army Group at Nagasaki, and a member of the Radiological Safety Section of the Naval Medical Research Group at Bikini.

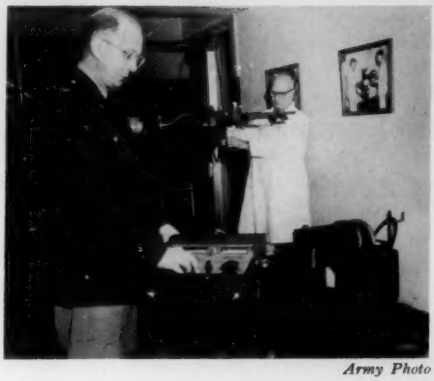
Prior to his present assignment General DeCoursey was Director of the Armed Forces Institute of Pathology, Washington, D.C.

CAMP DETRICK

Fort Detrick is the new designation for the installation formerly known as Camp Detrick, Maryland.

FIELD X-RAY UNIT

Colonel John A. Isherwood, Director of X-ray programs at the Army Medical Service School and Brooke Army Hospital, Fort Sam Houston, Texas, is shown here adjusting the control panel of an experimental field x-ray unit being tested at the school.



Army Photo

The equipment is expected to make possible field x-ray films with exposure times about the same as in permanent-type x-ray units—two to three seconds. The unit is 50 milliampere but can be increased to 100 milliamperes by use of a rectifying tank.

Navy

Surgeon General—Rear Adm. Bartholomew W. Hogan

Deputy Surgeon General—Rear Admiral Bruce E. Bradley

DOCTOR-AUTHOR

Dr. Thomas A. Dooley, III

Deliver Us From Evil is the story of the Navy's Passage to Freedom (August 1954-May 1955) as written by Lieutenant Thomas A. Dooley, III, MC, USNR. This book which was published in March has been used by *Reader's Digest* as the Book Condensation for the Month of April. The story is that of the North Viet Nam refugees as they fled from the terror of their Communist conquered lands.

ON EDITOR'S BOARD

Captain William M. Silliphant, MC, USN, Director, Armed Forces Institute of Pathology, has been appointed a member of the Board of Editors of the American Journal of Clinical Pathology. The journal is the official publication of the American Society of Clinical Pathologists.

CORRESPONDENCE COURSES

A complete list of naval officer correspondence courses may be found in the Catalog of Officer Correspondence Courses—NavPers 10800A. The following courses are considered especially valuable in preparing dental officers to meet the naval responsibilities of their present and next higher grade.

RECOMMENDED FOR DENTAL OFFICERS IN THE GRADE OF LTJG

Course	*Assignments*	*Reserve Points*
1. Naval Orientation—NavPers 10900	11	24
2. Naval Regulations—NavPers 10740A	12	24
3. Military Justice in the Navy—NavPers 10993	12	24
4. Dental Department Administration—DuMed (Available about July 1956)		

RECOMMENDED FOR DENTAL OFFICERS IN GRADE OF LT

Course	*Assignments*	*Reserve Points*
1. Navy Regulations—NavPers 10740A	12	24
2. Leadership—NavPers 10903	5	10
3. Military Justice in the Navy—NavPers 10993	12	24
4. Dental Department Administration—BuMed (Available about July 1956)		

RECOMMENDED FOR DENTAL OFFICERS IN THE GRADE OF LCDR

Course	*Assignments*	*Reserve Points*
1. Security of Classified Matter—NavPers 10975A	3	6
2. Education and Training Part I—NavPers 10965	7	14
3. Education and Training Part II—NavPers 10966	5	10
4. Military Justice in the Navy—NavPers 10993	12	24
5. Dental Department Administration—BuMed (Available about July 1956)		
6. U. S. Naval Dental Clinic Administration BuMed (Available about July 1958)		

RECOMMENDED FOR DENTAL OFFICERS IN THE GRADES OF CDR AND CAPT

Course	*Assignments*	*Reserve Points*
1. Organization for National Security NavPers 10721	5	10
2. Personnel Administration—NavPers 10968	6	12
3. Public Information—NavPers 10720	6	12
4. Military Justice in the Navy—NavPers 10993	12	24
5. Logistics—NavPers 10902	6	12
6. U. S. Naval Dental Clinic Administration BuMed (Available about July 1958)		
7. Operational Planning and Staff Organization—Naval War College	4	24

Requests for enrollment in correspondence courses with NavPers numbers should be on NavPers Form 992 to the U. S. Naval Correspondence Center, Building RF, U. S. Naval Base, Brooklyn 1, New York. Requests for enrollment in BuMed Courses should be on NavPers Form 992 to the Commanding Officer, U. S. Naval Dental School, NNMC, Bethesda, Maryland. Requests for enrollment in a Naval War College Course should be by official letter to President, Naval War College, Newport, Rhode Island. All naval officer correspondence courses are designed and intended for individual home study.

CORRESPONDENCE COURSES

X-Ray Physics and Techniques (NavPers 10702) is a new correspondence course for eligible Regular and Reserve officer and enlisted personnel. The course is evaluated at twelve promotion and non-disability retirement points. Applications for the course should be made on form NavPers 992 and forwarded through channels to the Commanding Officer, U. S. Naval Medical School, National Naval Medical Center, Bethesda 14, Md.

Naval Reserve officer and enlisted personnel who have completed the Special Clinical Services (general) correspondence course will *not* receive additional credit for completion of this course.

NAVAL INSTITUTE PRIZE WINNERS

Warren of Annapolis

(L to R) Dr. Maurice A. Hellner; Admiral Arleigh A. Burke, Chief of Naval Operations; Col. Wm. R. Kintner, USA.

American Responsibilities in the Nuclear Age is the subject of the prize winning essay of the U. S. Naval Institute. The author, Colonel William R. Kintner, U. S. Army, has received $1,200, a gold medal, and Life Membership in the Institute. The essay was published in the March issue of the *Proceedings* of the Institute.

Sea Power and the Struggle for Asia received Honorable Mention. That essay was written by Lt. Commander Maurice H. Hellner, USNR, who received a silver medal and $800. The essay appears in the April issue of *Proceedings.*

PUBLISHES BOOK

Understanding Human Behavior is the title of a new book recently published by Commander James L. McCartney, MC, USNR, Ret., of Garden City, N.Y., a practicing psychiatrist. He is a member of this Association.

This is Dr. McCartney's third book and in it he discusses the foundations of personality and the numerous technics used by psychiatrists to diagnose and treat maladjusted individuals.

DENTAL RECORDS

Identification of the dead aboard the Marine Corps plane that crashed in California in February was made possible by the dental records on file in the Bureau of Medicine and Surgery, Navy Department, at Washington. Records of those on the passenger list were telephoned to a dental officer on duty at the Naval Hospital, Oakland, California.

COMMAND CHANGE NMRI

Captain Otto E. Van Der Aue, MC, has assumed command of the Naval Medical Research Institute at the National Naval Medical Center, Bethesda, Maryland. He relieved Captain Wilbur E. Kelum, MC, who had been in command since June 20, 1951.

Captain Van Der Aue is a medical specialist and authority on submarine and diving practice, and associated morbidity.

CIVILIAN HOSPITAL ADMINISTRATORS

The Medical Service Corps, U. S. Naval Reserve, is now open to civilian hospital administrators who may desire to apply for commissions in that corps.

Applicants must hold a Master's Degree in Hospital Administration from one of the universities listed in Recruiting Service Instruction 351.4, and must be under 32 years of age at the time of appointment. All appointments will be made in the grade of Ensign.

RETIRED

Rear Adm. David C. Gaede, MC; Capt. Dirk H. teGroen, MC; CDR Mary L. Benner, NC (Murray Hill Drive, Lancaster, Pa.) CDR Jerome B. Casey, DC; LCDR George H. Powers, MC; Lt. Alvin C. Pullum, MSC; Lt (JG) Bruce C. Jeppson, MC.

Air Force

Surgeon General—MAJ. GEN. DAN C. OGLE
Deputy Surg. Gen.—MAJ. GEN. W. H. POWELL, JR.

ASSIGNMENTS

Colonel Ralph E. Switzer has been assigned as Staff Surgeon of the Central Air Defense Force at Grandview Air Force Base, Mo.

Colonel Clarence A. Tinsman has been assigned to the Office of the Surgeon General, Air Force, Washington, D.C.

TOWER OF BOUBEL

No, we have not made a mistake in spelling. The name in the caption is that given to the office of Mrs. Robert J. Boubel, Jr., and her father at the Air Force School of Aviation Medicine, Randolph Field, Texas.

Mrs. Boubel and her father are linguists, he with a knowledge of eight languages, she being able to handle seven. With the many foreign students enrolled in the school the "Tower of Boubel" has become a busy place.

Public Health Service

Surgeon General—LEONARD A. SCHEELE, M.D.
Deputy Surg. Gen.—W. PALMER DEERING, M.D.

ADVISORY ALLERGY COUNCIL

The Surgeon General of the Public Health Service has announced the appointment of ten members to the newly established National Advisory Allergy and Infectious Diseases Council. They are:

Dr. René J. Dubos, member of the Rockefeller Institute for Medical Research, New York.

Dr. Karl F. Meyer, Director of the G. W. Hooper Foundation, University of California Medical Center, San Francisco.

Dr. Gail M. Dack, Director of the Food Research Institute, University of Chicago.

Dr. Edwin B. Fred, President of the University of Wisconsin, Madison.

Dr. Charles E. Smith, Dean of the School of Public Health, University of California, Berkeley.

Dr. H. O. Halvorson, Head of the Department of Bacteriology, University of Illinois.

Mr. Byron H. Larabee, President of Firestone Plantations Company, Akron, Ohio.

Mr. David C. Crockett, Associate Director, Massachusetts General Hospital, Boston.

Mrs. Rollin Brown of Los Angeles, President of the National Congress of Parents and Teachers.

Mr. John Abbink, of New York, President of the American Foundation for Tropical Medicine.

STUDY PATIENT CARE

During March and April the American Hospital Association and the Public Health Service are sponsoring studies of patient care in hospitals. One purpose of these studies is to determine to what extent the number of hours of nursing care provided each patient contributes to his satisfaction with his hospital stay.

Another objective is to find out what nurses and other members of the hospital staff think about the nursing services they are able to provide. From the facts obtained, the participating hospitals expect to develop ways of improving patient care.

LUNG CANCER

A Quest into the Environmental Causes of Cancer of the Lung is the title of a 54-page monograph, recently published by the Public Health Service. The author is Dr. W. C. Hueper, Head of the Environmental Cancer Section of the National Cancer Institute,

National Institutes of Health, Bethesda, Maryland.

The monograph is available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C. for 45¢.

HEPARIN

Recent advances in the study of heparin, first discovered in 1916, may assist in determining the chemical structure of this anticoagulant.

An obscure soil organism found on the grounds of the National Institutes of Health, Bethesda, Maryland, may be the key in the analysis of this chemical. The work was described in a recent issue of *Nature*.

Veterans Administration

Chief Medical Director—WILLIAM S. MIDDELTON, M.D.
Deputy Chief Med. Dir.—R. A. WOLFORD, M.D.

ASSIGNMENTS

Dr. George M. Lyon, Assistant Chief Medical Director for Research and Education in the Veterans Administration's Department of Medicine and Surgery, was assigned to the position of manager of the VA hospital at Huntington, West Virginia, effective April 1.

Dr. Haughton W. Baxley, manager of the VA hospital, at Huntington, W.Va., has been reassigned to professional duties with the Department of Medicine and Surgery.

VETERAN POPULATION

The average age of the more than 22 million living veterans is 38½ years. The oldest, Albert Woolson of Duluth, Minn., is 109 years; he is a veteran of the Civil War. The largest group of veterans, mostly those of World War II, fall within the 30-34 year age bracket. That group numbers approximately 5,158,000.

Based on a Veteran Administration survey as of December 31, 1955, following is a breakdown by war showing the number of participants, number of deaths in service, estimated number of living veterans and their average age:

Korean Conflict Period—6,807,000 participants (includes 1,476,000 who served both in World War II and during Korean Conflict period); 54,000 deaths in service; 4,346,000 living veterans (includes 843,000 who served both in World War II and during Korean Conflict period); average age 27 years.

World War II—16,535,000 participants (includes 1,476,000 who served in World War II and during Korean Conflict period); 409,000 deaths in service; 15,391,000 living veterans (includes 843,000 who served both in World War II and during Korean Conflict period); 36½ years.

World War I—4,744,000 participants; 131,000 deaths in service; 3,105,000 living veterans; 62 years.

Spanish-American War—392,000 participants; 11,000 deaths in service; 68,000 living veterans; 78½ years.

Indian Wars—106,000 participants; 1,000 deaths in service, 176 living veterans; 89 years.

VA said 31,800,000 persons participated in all wars, including the Revolutionary war.

VOLUNTARY SERVICE ANNIVERSARY

The Tenth Anniversary of the *Veterans Administration Voluntary Service* will be April 15. Instead of a heterogenous group working in many uncoordinated directions the Voluntary Service now has an organized trained group of volunteers who assist the regular staff in Veteran Administration hospitals. This volunteer group of local people are engaged in work in 25 different hospital programs giving the veteran something in addition to the essential medical care provided by the hospital. Workers are finding this great field of service a source of much satisfaction to them as to the veterans whom they serve.

HOME OWNER BOOKLET

Pointers for the Veteran Homeowner is a recently published booklet, now available at all Veterans Administration offices, for the asking.

This 21-page booklet is a guide for veterans whose home mortgage is guaranteed or insured under the GI Bill. This booklet covers many subjects: the mortgage, insurance, selling or renting the home, and taxes. Every veteran who has a mortgage on his home should read this booklet.

MONOGRAPHS

Tuberculosis in the Army of the United States in World War II is an 88-page monograph recently published under the sponsorship of the Veterans Administration. It is an epidemiological study by Esmond R. Long, M.D., Director, Henry Phipps Institute, University of Pennsylvania; and Seymour Jablon, A.M., Statistician, National Research Council.

This monograph can be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., for $1.50.

A Follow-Up Study of World War II Prisoners of War is the title of a VA monograph by Bernard M. Cohen, Ph.D., and Maurice Z. Cooper, M.D. This 80-page book is available from the Sup't. of Documents, Government Printing Office, Wash. 25, D.C., for $1.50.

Miscellaneous

AERO MEDICAL MEETING

The Annual Meeting of the Aero Medical Association will be held at the Drake Hotel, Chicago, Illinois, on April 16, 17, and 18.

This year's meeting will provide the most comprehensive review of current progress in Aviation Medicine ever presented. There will be 137 papers presented dealing with every aspect of the field and coming from military and civilian sources in nine countries.

The Wives Wing of the Association will hold its annual functions on the same dates.

Members of the profession and their wives are cordially invited to attend any or all of these sessions.

MEETING

The Medical Library Association will hold its 55th Annual Meeting at the Hotel Statler, Los Angeles, Calif., June 18 to 22. Further information may be obtained from Mrs. Ella Crandall, Librarian, Los Angeles County General Hospital, 1200 N. State St., Los Angeles 33, Calif.

MEETING

The American College of Chest Physicians will hold its 22nd Annual Meeting at the Hotel Sherman, Chicago, Ill., June 6-10. Examination for Fellowship in the College will be held June 7.

More than 150 physicians will receive their certificates of Fellowship at the annual Convocation on June 9. Physicians are welcome to attend the meetings; there is no registration fee. The Executive Office of the College is located at 112 East Chestnut St., Chicago 11, Ill.

INTERAGENCY INSTITUTE

The twelfth Interagency Institute for Federal Hospital Administrators, sponsored by the Army this time, will be held at the Walter Reed Army Medical Center April 23 through May 11.

Colonel Byron L. Steger, MC, U.S. Army, has stated that the objective of the Institute is to offer senior federal hospital officials training in: (1) how to provide better patient care through better administration; (2) the skills needed to meet day-to-day problems; and (3) the latest management methods and techniques consistent with new trends in medical care.

Graduation ceremonies will be held May 11.

MANAGEMENT CONSULTANT SPEAKS

Jerome Barnum, Director of Jerome Barnum Associates, management consultants,

said recently in a talk before the American Pharmaceutical Manufacturers' Association that "people have three basic desires that we as management must fulfill. They desire security—the internal security of being accepted as a full member of the human race. They desire recognition—reward for achievement, not just penalty for failure. And they desire self expression."

RESOLUTIONS

Two resolutions of the 18th Session of the International Office of Documentation of Military Medicine, which met in Istanbul, Turkey, August 28 to September 1, 1955 are here presented: Resolution 1:

(1) that in case of failure of the Protecting Powers to do so, the International Committee of the Red Cross assume the humanitarian tasks normally devolving upon those Powers, including the supervision of the application of the Geneva Conventions;

(2) that in case, as a result of exceptional circumstances, it becomes impossible for the International Committee of the Red Cross to carry out that task, it take all measures necessary to ensure its continuity;

(3) that, in such event, it determine in time of peace the organization and plan of operation of a body that could take over the task of supervising the application of the Geneva Conventions;

(4) that a study of this question be made by the International Committee of the Red Cross so that it can appear on the agenda of the Congress of Belgrade in 1957.

The 18th session of the International Office of Documentation of Military Medicine calls to the attention of all governmental authorities the fact that the voluntary cooperation of the Public Health Services of neutral countries should be extended as generously as possible to all victims of conflicts.

It emphasizes that the task of supervising that assistance, and the task of ensuring that the humanitarian conventions are respected, can be considered only under the auspices of the Protecting Powers or of the International Committee of the Red Cross, or, failing that, the auspices of the substitute body the establishment of which is under consideration.

To that end, it expresses the *voeu* that such supervision be exercised at very frequent intervals or, better still, continuously by permanent delegates appointed for that purpose.

It is desirable that a thorough study of this question be made without delay.

COMMEMORATIVE MENDEL MEDAL

A beautiful silvery bronze medal was issued by the Gregory Mendel Institute for Medical Genetics, Rome, Italy, to commemorate the ninetieth anniversary of the discovery of the Mendelian laws of heredity. On its face, the medal bears the head of Gregory Mendel, Augustinian abbot at Brünn, who, by his experiments with plant hybridization, became the founder of modern genetics. On its reverse, the medal shows the Institute for Medical Genetics erected in Rome and opened in 1953.

The medal, which was cast in limited numbers, was sent by Dr. Luigi Gedda, the Director of the Institute, to noted geneticists and the friends and collaborators of the Mendel Institute. One of the members of our Association, Dr. Claudius F. Mayer, was awarded the medal for his work "Genesis of Genetics," a historical presentation at the opening of the Roman Institute. Dr. Mayer was recently honored by the American Association for the Advancement of Science by being elected a Fellow of that association.

REPRESENTS ASSOCIATION

Colonel Roland I. Pritikin, MC, USAR, is representing our Association at the Middle East Medical Assembly being held at the American University of Beirut, Lebanon, April 7-9. Colonel Pritikin, who is located in Rockford, Illinois, specializes in diseases of the eye.

PROSTHETIC REHABILITATION COURSE

New York University has established a prosthetics rehabilitation education program

designed for physicians, surgeons, prosthetists, and therapists concerned with artificial limbs and other replacement devices for amputees.

Information may be obtained from the New York University Post-Graduate Medical School, 550 First Avenue, New York 16, N.Y.

PEDIATRICS COURSES

Three courses in pediatrics will be given by the University of Pennsylvania Graduate School of Medicine during the period May 28 through June 8. Further information may be obtained about these courses from Irving J. Wolman, M.D., Children's Hospital of Philadelphia, 1740 Bainbridge St., Philadelphia 46, Pa.

PENTAGON FIRST AID TRAINING

A First Aid Training Program for employees of the Department of Defense has been revitalized at the Pentagon. Major General John G. Van Houten, Commanding General of the Military District of Washington, recently presented certificates of completion of the first course in the revitalized program to 80 persons.

Colonel C. D. Goodiel, Surgeon of the Military District of Washington, is in charge of the program and has a staff of nurses from the Civilian Employee Health Service to assist him.

Graduates of the program are given 12 hours of instruction and those desiring may advance to the position of instructor with additional hours of training, providing they demonstrate sufficient aptitude.

RESEARCH OPPORTUNITIES FOR SUMMER

Medical Student Research Fellowships, available to medical schools throughout the United States and Canada, are now being offered for the current year by Lederle Laboratories Division, American Cyanamid Company.

Selection for these Fellowships will be made at the medical school and must have the consent of the faculty member under whose supervision the research is to be conducted. Up to $600 will be allowed for any one individual.

ABSTRACT

The importance of the health program developed to protect Panama Canal workers is shown to parallel, in the health field, that of the completion of the Canal in the social and economic fields. This study outlines the difficulties encountered and successive development of methods; it illustrates how a hypothesis was verified and became an established principle upon which control measures are based.

Conversion of the Canal Zone from an area of "pestilence" to one of optimum health stands as a classic. The methods continue, with minor modifications, to be the key to malaria control. The importance of permanent and semi-permanent sanitary engineering works, larviciding, mosquito-surveillance studies, and the use of chloroquine and primaquine are emphasized. Endemic malaria is predominantly *P. falciparium;* over 90 percent of the occasional cases in short-term residents are *P. vivax*. A two-year follow-up of malaria patients treated with chloroquine and primaquine shows a one-percent reinfection or relapse. Endemic foci of malaria exist in close proximity to relatively malaria-free sanitated communities of the Canal Zone.

(*Fifty Years of Malaria Control in the Panama Area.* Lt. Col. Edw. J. Dehne. Amer. J. Trop. Med. & Hyg. 4:800-Sept., 1955.)

ANATOMY IN STEREO

"The Upper Extremity" which is Section III of the *Stereoscopic Atlas of Human Anatomy* was recently released by the producers of View-Master, Sawyer's, Inc., of Portland, Oregon. This section consists of 28 stereo views of the dissected upper extremity with 3 text volumes of sketches and nomenclature.

The dissection was done by Dr. David L. Bassett, Associate Professor of Anatomy,

Stanford University, California; the photography by William B. Gruber. The three-dimensional views are on 16 mm film on the familiar circular disc for use with the Sawyer stereoscope. These films are in color and the dissection stands out clearly; the sketches in the accompanying 6½ × 8½ books, three in number, are in black and white. Since pins and numbers are eliminated on the films cluttering of the picture is avoided.

In these days when we are told that material for dissection is very limited and as many as ten medical students are assigned to one cadaver, a work of this kind is definitely needed. These films with the accompanying texts afford an opportunity for either leisurely study or quick review. Mental pictures can certainly be better maintained by the third dimension approach. Here is a work for anyone who needs to know human anatomy.

DOCTOR MURRAY SNELL DANFORTH FUND

A bequest of $10,000 has been left by the late Miss Agnes H. Danforth to establish the above named fund, the income from which will be used to award scholarships to residents of Maine "who are students at Bowdoin College preparing for the medical or related professions."

Dr. Danforth served his country in the Army Medical Corps in World War I. At the request of Sir Robert Jones, he went to England as one of a group of twenty orthopedic surgeons whose skills were regarded as exceptional for the task of caring for war casualties. After the war he joined the orthopedic staff at Walter Reed Hospital as consulting surgeon, with emphasis on physical rehabilitation.

CURE FOR BALDNESS

Professor Lawrence Taylor of Hillsdale College recently told the American Pharmaceutical Manufacturers' Association representatives assembled in Chicago of an African remedy for baldness. Bald heads would be shrunk to fit the hair. He did not mention how the ivory heads would be taken care of.

In a more serious vein, the humorist listed three stages of baldness—fear, fight, and flight. The first indications of baldness produce fear and unbelief, he said. This is followed by fight, which means trying the patent remedies, all of which fail. And then comes flight, where, by combing, a person tries to do the most he can with what little he's got.

Along the same line Federal Trade Commission examiner Earl J. Kolb said that there "is no cure known to medical science for 90-95% of the cases of baldness." This was a statement in connection with advertising claims of some patent medicine producers.

SOME FACTS

In a recent talk the Honorable Herold C. Hunt, Undersecretary of the Department of Health, Education, and Welfare, cited these facts: the population of the United States is 166 million; there is a birth every 12 seconds; there are 41½ million young people in college; in ten years there will be 55 million in college; there are 48 million households in the U.S.; in ten years there will be 56 million households; there are at present 14 million persons in the United States 65 years of age or older; in ten years that number will be increased to 17 millions; in 1942 there were 40 deaths in the first year of life among 1000 babies born; this has been reduced to 26 per 1000; the life expectancy has increased 5 years in the past decade.

PHARMACY FACTS

Enrollment in U.S. schools and colleges of pharmacy in the first semester of 1955-56 was the highest in the last five years.

More than 450,000,000 prescriptions were filled by U.S. drug stores in 1955 according to reliable trade sources.

KNOW HIM?

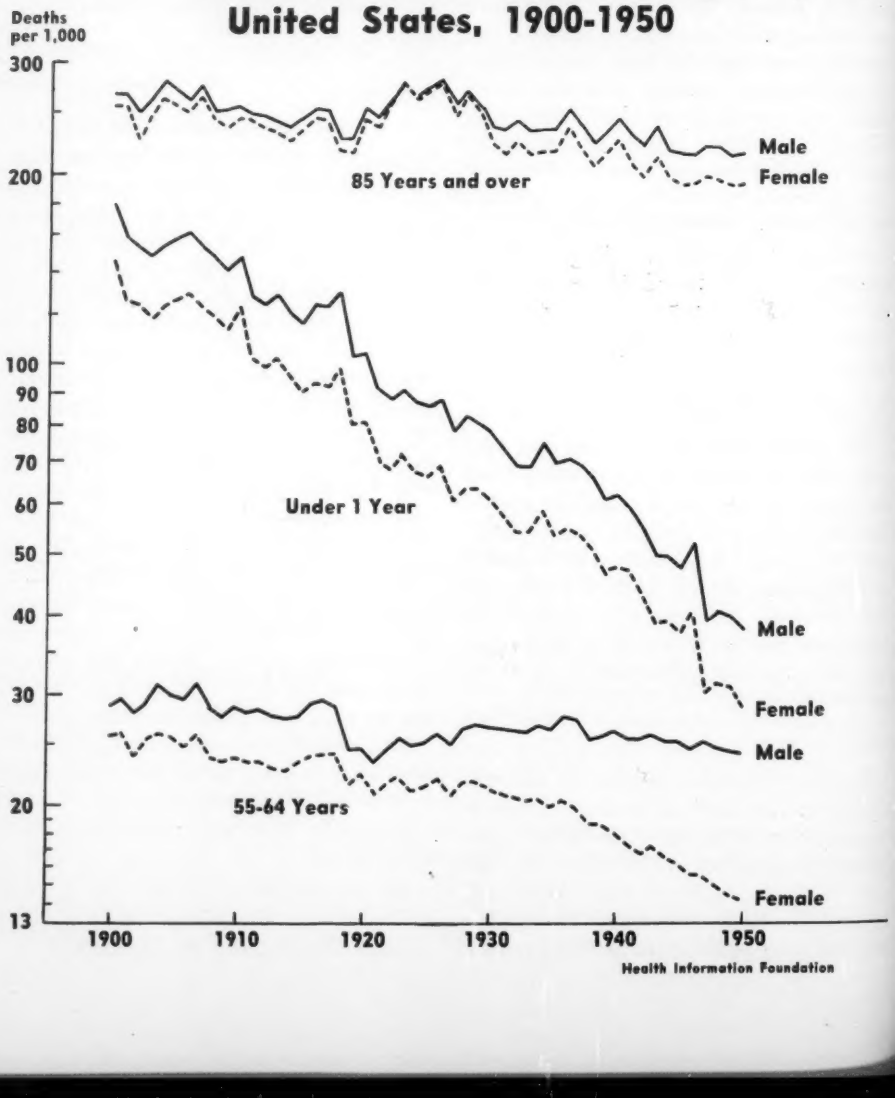
We had to give up on this one—a letter addressed to: Mr. Ben Franklin, Editor, Military Surgeon, Box 80, Wash., D.C.

Honor Roll

Since the publication of our last list, the following sponsored one or more applicants for membership in the Association:

Col. Norman W. Anderson, MC, U. S. Army
Lt. Col. Edwin G. Benjamin, MC, USAR
Col. Curtis W. Betzold, VC, U. S. Army
Lt. Col. Charles T. Brown, USA, Ret.
Robert C. Cornell, M.D.
Med. Dir. John W. Cronin, USPHS
Lt. Col. Charles V. L. Elia, VC, U. S. Army
Major Gen. Alvin L. Gorby, MC, U. S. Army
Lt. Col. Wistar L. Graham, USAF (MC)
Louis A. Hazouri, M.D.
Lt. Cdr. Maxwell M. Hoffman, MSC, USNR
Brig. Gen. James A. McCallam, USA, Ret.
Col. Ralph W. Mohri, VC, U. S. Army
Capt. E. Ricen, MC, U. S. Navy
Col. Louis F. Saylor, MC, U. S. Army
Capt. Christopher C. Shaw, MC, U. S. Navy

Death Rates for Selected Ages by Sex
United States, 1900-1950



OBITUARIES

Capt. Joseph Aloisius Nowicki, M.C., Mich. NG

Joseph Aloisius Nowicki, Captain, M.C., Mich. NG, died August 25, 1955, in Detroit where he had practiced for many years.

Captain Nowicki received his medical degree from the University of Buffalo School of Medicine, 1912; served during World War I; on the staff of Grace Hospital. He had been a member of the Association since 1928.

Captain Nowicki died in the Redford Branch of the Receiving Hospital, Detroit, at the age of 66, of fracture of the skull when his automobile was struck by a train.

Lt. Col. Thomson Edwards, A.U.S.

Thomson Edwards, Lt. Colonel, A.U.S., died in the Veterans Administration Hospital, Philadelphia, Pa., December 4, 1955, at the age of 68.

Colonel Edwards was a native of Pennsylvania. He received his medical degree from the University of Pennsylvania School of Medicine in 1912. He joined the Veterans Bureau in 1921 and served in the Veterans Administration until 1953 when he retired after 32 years of service credit. During World War I and II he served in the Army Medical Corps. He was a Fellow of the American Medical Association and a member of the Association of Military Surgeons of the United States.

Lt. Col. Jerome L. Rosengard, U.S.A.R., Ret.

Jerome Livingston Rosengard, Lt. Colonel, U. S. Army, Retired, died at Stockton, California, December 20, 1955, at the age of 55.

Colonel Rosengard was native of Chicago, Illinois. He received his medical degree from the University of Illinois College of Medicine in 1926. He served in the Army Medical Corps during World War II and was retired for physical reasons in April 1946. From 1947 to 1952 he was on the teaching staff of Loyola University Stritch School of Medicine in Chicago. At the time of his death he was on the staff of the Stockton State Hospital, Stockton, Calif.

Colonel Rosengard was a Fellow of the American Medical Association, a member of the Association for the Advancement of Science, American Heart Association, and the Association of Military Surgeons of the United States.

Col. F. E. Fronczak, U.S.A.R., Ret.

Francis Eustace Fronczak, Colonel, U. S. Army Reserve, Retired, died in Buffalo, New York, December 27, 1955 at the age of 81.

Colonel Fronczak was a native of Buffalo, New York. He received his medical degree from the University of Buffalo School of Medicine in 1897. During World War I he was wounded in the Marne Offensive in 1918. He served on the Polish National Committee in Paris and was in charge of the Polish Army welfare; in 1919 he was a medical adviser to the first Red Cross Commission to Poland; in 1946 he served as coordinator to the Polish Mission of the United Nations Relief and Rehabilitation Administration. For many years he was Commissioner of Health in Buffalo. He was Emeritus Associate Professor of Hygiene

and Preventive Medicine at the University of Buffalo School of Medicine.

Colonel Fronczak was awarded the Purple Heart, Knighthood in the French and Belgian Legions of Honor, Croix de Guerre, Medaille Militaire (France), Haller's Swords and the highest Polish decoration in the Order of Polonia Restituta, Republic of Poland. He was a member of the American Medical Association, the American Public Health Association, and the Association of Military Surgeons of the United States.

Col. Henry Beeuwkes, U.S. Army, Ret.

Henry Beeuwkes, Colonel, U. S. Army, Retired, died at St. Petersburg, Fla., on January 31 at the age of 74.

Colonel Beeuwkes was a native of New Jersey. He received his medical degree from Johns Hopkins Medical College in 1906. In 1909 he was commissioned in the Army Medical Corps and became aide and physician to General Pershing in France (1917-1919). From 1921-1923 he was American Relief Administrator to Russia in which position he helped to rehabilitate many hospitals and dispensaries.

In 1925 Colonel Beeuwkes became Director of the West African Yellow Fever Commission of the Rockefeller Foundation and served in that capacity until 1934. After that he served on the Cornell University Medical College staff and did research on tuberculosis for a period of five years. During World War II he was recalled to active duty. He organized and commanded Valley Forge Army Hospital at Phoenixville, Pa. This hospital is still in operation.

Colonel Beeuwkes was the author of articles on yellow fever and tuberculosis. He was a Fellow of the American College of Surgeons, a member of the American Medical Association and the Association of Military Surgeons of the United States. He was awarded the Distinguished Service Medal, Legion of Honor (officer) France, Grand Medalle Epidemie, France, Mary Kingsley Medal of Liverpool, and the Hoff Medal (Army Medical School).

He is survived by his widow, Mrs. Mary K. Beeuwkes whose address is 6346 Bahama Shores Drive, St. Petersburg, Fla.

Interment was at Arlington National Cemetery.

Rear Adm. A. Farenholt, U.S. Navy, Ret.

Ammen Farenholt, U. S. Navy, Retired, died February 12 in San Diego, Calif., at the age of 84.

Admiral Farenholt was a native of Virginia. He graduated from Harvard Medical School in 1893 and entered the medical service of the Navy in 1894. He was appointed to the rank of Rear Admiral in 1930 and retired from the Navy on January 1, 1936. During the Spanish American War he was on the USS *Charleston* when that ship was ordered to convoy troops to Manila after Admiral Dewey's message of May 7th stating "I control bay completely and can take city at any time but I have not sufficient men to hold." The ships arrived in Manila Bay on June 30, 1898.

Admiral Farenholt's last assignment was Inspector, Medical Department Activities, West Coast, with additional duty as District Medical Officer, Eleventh Naval District, Headquarters in San Diego.

He is survived by his daughter, Mrs. Ruth M. Tobey, 3626 Hyacinth Drive, San Diego, Calif.

Brig. Gen. Edward J. Kendricks, U.S.A.F.

Edward J. Kendricks, Brigadier General, U. S. Air Force Medical Corps, died of a heart attack at Randolph Air Force Base, Texas, on February 17 at the age of 56.

General Kendricks was a native of Michigan. He received his medical degree from Northwestern University in 1922 and practiced his profession in Detroit until 1930

when he entered the Army Medical Corps. He became interested in aviation medicine and psychiatry and after his graduation from the School of Aviation Medicine in 1934 he devoted the rest of his military career to the care of military flyers. In 1937 he returned to the School of Aviation Medicine as Chief of the Department of Neuropsychiatry.

At the outbreak of World War II he was called to Washington to become surgeon of the 376th Bombardment Squadron, the "Halverson Detachment," a task force for Africa with a mission to bomb Japan from the Asiatic mainland. The force was diverted, however, to the support of Allied forces defending the Suez Canal, then threatened by Rommel's army. The unit became the nucleus of the Ninth Air Force which took part in the European campaigns. General Kendricks remained as the surgeon.

After the war General Kendricks served as Chief of the Aero Medical Laboratory at Wright-Patterson Air Force Base; Director of Medical Staffing and Education, Office of the Surgeon General, Air Force; and then became Commandant of the School of Aviation Medicine, Randolph Air Force Base, Texas, which position he held at the time of his death.

General Kendricks was awarded the Bronze Star, the Soldier's Medal, the French Legion of Honor, and the Croix de Guerre with palms of Belgium, France, and Luxembourg. He was a member of the American Medical Association, the Association of Military Surgeons of the United States, and the Aero Medical Association. In 1951 he delivered the Kober Lecture at Georgetown University, Washington, D.C., on the subject "Medical Problems of Military Aviation."

He is survived by his wife, Mrs. Wanda Hunt Kendricks. Interment was at Arlington National Cemetery.

K. P. or not K. P.

By

SPECIALIST 2ND CLASS PAT RUTTER
Associate Editor, Fort Myer, Va., "Post"

Have you ever considered how many ways the word "K.P." (Kitchen Police) is expressed?

The agonizing cry of "K. P. again" that tears from a man's mouth when he sees his name on the roster.

The inquisitive words of the Charge of Quarters as he searches in the morning, "Are you K. P.?"

The relieved expression of the cooks when the K. P.s turn up in the morning, "The K. P.s are here, we can relax."

The sneering expression of persons who don't pull K. P. "Hey K. P., where's the silverware?"

The respectful question of the guy on duty the next day, "How's K. P. going buddy?"

The friendly attitude of the Mess Sergeant when he's mooching, "Hey, K. P. ol' pal, got a cigarette?" The unfriendly attitude if he doesn't get it—"What do ya mean the water's too hot, you still got skin on your hands."

The gay answer the Recruiting Officer has during the re-up talk. "K. P., heh heh, just one of those things, heh, heh."

And last the sentimental expression when you're a hungry civilian. "Good ol' K. P., always plenty to eat."

BOOK REVIEWS

FIFTEEN DECISIVE BATTLES OF THE WORLD. By Sir Edward S. Creasy, 471 pages. Military Service Publishing Co., Harrisburg, 1955. Price $3.50.

In 1851 Edward Creasy saw the first publication of his classic work, *Fifteen Decisive Battles of the World.* By 1856 this book had gone through seven editions, and in the last hundred years many more have gone to press. Why? For the simple reason that the book is written in a highly charming and readable style, and makes military history palatable to the general reader. The battles he termed decisive were Marathon, the Athenian defeat at Syracuse, Arbela, the Metaurus, the Teutoberger Forest, Chalons, Tours, Hastings, Orleans, the Spanish Armada, Blenheim, Poltava, Saratoga, Valmy and Waterloo.

At the time this book was written there had been no great battles since Waterloo. In the last century, unfortunately, decisive battles have had a tendency to accumulate, and a similar book written today would go far beyond fifteen engagements. Though Creasy makes a good case for his choices, some of them now do not seem so important. But nevertheless Sir Edward's book will no doubt pass through many more editions because of its sheer excellence.

ROBERT WALKER DAVIS

CANCER CELLS. By E. V. Cowdry, Director, Wernse Cancer Research Laboratory, Washington University, St. Louis. 677 pages, illustrated. W. B. Saunders Co., Philadelphia and London. 1955. Price $16.00.

This book is an excellent compilation of information about cancer in general. Its scope is much broader than might be indicated by the title. The first few chapters discuss cancer from the point of view of the cellular changes which characterize a cancer cell. This involves discussion of differentiation and dedifferentiation, organizers, evocation and individuation, uncontrolled cellular multiplication, speard of cancer cells, polyploidy, pinocytosis, clasmatosis, viscosity of cells, mineral constituents, mitochondria, the Golgi apparatus, endoplasmic reticulum, ergastoplasmic sacs, polarity and centrosomes.

A chapter devoted to nuclear changes includes such topics as the nuclear membrane, nucleoli, chromocenters, chromonemic threads, nuclear sap, mitotic time and rhythm and mitotic poisons. The chemical constituents of the nucleus and of cancer tissues in general are summarized in relation to the chemistry of normal cells and tissues. Cancers in animals and plants are examined for clues to human cancers.

There is a comprehensive chapter on carcinogenic agents and chapters on viruses and mutations as carcinogenic agents. Other chapters include discussion of cellular susceptibility and the influence of heredity, age and sex.

The period between the initiating action of a carcinogen and the appearance of a cancer is often so long as to permit such factors as diet, age and environment to play a part. For example in carcinoma of the bladder in dye workers the period between exposure and appearance of the tumor may be as long as 15 years. A chapter is devoted to a discussion of this latent period in the development of cancer.

The subject of the frequency of cancer of different sites in various geographic areas and among various population groups is well covered.

There is a chapter on cancer prevention and one on diagnosis and treatment and a final chapter lists the important events in the history of cancer research.

Dr. Cowdry is an authority in the field of cancer research particularly as regards investigations of the cancer cell. The information which he has compiled in this book will be of interest to any one studying the cancer problem. It is information which has been collected from many different sources and which is not contained in the usual text books.

COLONEL HUGH R. GILMORE, JR., MC, USA

PROGRESS IN NEUROLOGY AND PSYCHIATRY: AN ANNUAL REVIEW. Vol. X. Edited by E. A. Spiegel, M.D., Temple University.

645 pages. Grune and Stratton, New York and London. 1955. Price $10.00.

For the reader who can work through it page by page, the tenth annual volume of *Progress in Neurology and Psychiatry* provides an expertly organized condensation and digest of over 1,400 papers. Many students, understandably, will page through parts of it, read others, and return the book to the reference shelf. Its principal function, as with companion volumes, will be as a reliable guide to the year's literature.

This volume is the production of seventy contributors and an editorial staff of six. Four major categories (basic sciences 110 pages, neurology 183 pages, neurosurgery 65 pages, and psychiatry 210 pages) are in turn divided into thirty-six chapters, each consisting of a narrative account and a reference list. Discussions in general are weighted in favor of the more significant advances in knowledge. A few works in French and German are cited, but it is difficult to guess how extensively the non-English literature was reviewed. One of the longest chapters (42 pages), Physiodynamic Therapies (Shock and Drug therapies), reflects continuing interest in the empiric-symptomatic treatments.

LCDR THOMAS H. LEWIS, MC, USN

MENTAL HYGIENE IN PUBLIC HEALTH. 2nd Ed. By Paul V. Lemkau, M.D., School of Hygiene and Public Health, Johns Hopkins University. 486 pages. McGraw-Hill Book Company, Inc., New York. 1955. Price $8.00.

The first edition of this book, published in 1949, was favorably received, and highly praised as a most useful pioneer contribution to the field of mental health. This second edition has been enlarged and improved, partly as a result of the author's experience for several years as Chief of the Division of Mental Health of the Maryland State Health Department. The author also served with the United States Army for four years as a Neuropsychiatrist, and is now on leave from Johns Hopkins as Director of Mental Health Services of the New York City Community Mental Health Board. He is obviously well-qualified to write on mental hygiene, and he does so in a most able manner.

Part One of the book, comprising about one-quarter of the whole, discusses the place of mental hygiene in public health, outlining the scope of this science, its techniques, and the organization and practices required for mental hygiene in public health work. Part Two is devoted to the mental and emotional development of the individual from conception to death. It is divided into appropriate age groups, from infancy to old age, and is a lucid and sensible description of behavior and psychiatric problems in the American populace. Appendices give a review of psychopathological states, and useful lists of visual aids in the field of mental hygiene. Each chapter has a comprehensive bibliography, and there are many interesting case reports.

The book is very well printed, and has a good index. As Dr. Hugh R. Leavell of Harvard says in a Foreword, the author has been personally involved in much of the recent progress and maturation of mental hygiene, and is particularly well-qualified to interpret this important field for the non-specialist. The book should be of great value and interest to all civilian and military health officials, and to physicians generally.

JAMES A. TOBEY, D.P.H.

SURGERY OF THE AMBULATORY PATIENT. 3rd Ed. L. K. Ferguson, M.D., F.A.C.S., Professor of Surgery, Graduate School of the University of Pennsylvania. Section on Fractures by Louis Kaplan, M.D., F.A.C.S., Senior Attending Surgeon, Albert Einstein Medical Center. 866 pages, illustrated. J. B. Lippincott Co., Philadelphia and Montreal. 1955. Price $12.00.

Dr. Ferguson has justifiably perpetuated this very useful and informative volume in its third edition and presents the subject in bold, clear to read, two-column print, with a well organized content, reference index and abundant illustrations.

The authoritative contributors, Dr. H. H. Stone, Lt. Col. E. J. Pulaski, Dr. Harry Burros and Dr. Louis Kaplan, cover their respective specialties of Anaesthesia, Antibiotics, Genito-Urology, and Fractures in a concise, practical and up to date manner.

This book is the obvious handiwork of an outstanding teacher, and will certainly continue to maintain its high position of usefulness in a practical down to earth application of sound accepted methods for the hospital admission room doctor and the general practitioner.

The sub-section on "Aberrant Thyroid Adenomas" is assumed to be an oversight in editing in that no mention is made of the accepted concept of metastatic carcinoma of the thyroid.

CAPT. R. M. MUGRAGE, MC, USN

HENRY FORD HOSPITAL INTERNATIONAL SYMPOSIUM ON CARDIOVASCULAR SUR-

GERY: STUDIES IN PHYSIOLOGY, DIAGNOSIS AND TECHNIQUES. Edited by Conrad R. Lam. 543 pages. W. B. Saunders Company, Philadelphia. 1955. Price $12.75.

This book presents the material from the symposium held at Henry Ford Hospital, March 17-19, 1955. There were sixty participants, seventeen discussants, and 478 registrants from thirty-five states and twenty-two foreign countries. The group is made up of most of the pioneers in the field as well as those identified with recent advances and current problems. There are formal papers on many subjects, verbatim panel discussions, questions and answers, and the foreword is the text of the banquet address given by Sir Russell Brock. The subjects treated include diagnostic techniques, pulmonic stenosis, adjustments between the systemic and pulmonary circulation, pathologic considerations in these adjustments, evaluation of transportation operations, mitral stenosis and insufficiency, aortic stenosis and insufficiency, septal defects, cardiac arrest, hypothermia, and aneurysms and occlusive aortic disease. Both internists and surgeons participated with full and frank expressions of current opinion. This book is not for the beginner in the field but will be invaluable for those more than casually interested in the clinical aspects and for those interested in the newer knowledge, investigative progress, and research trends. For a book made up of papers interspersed with verbatim dialogue, it is unusually readable and very informative. The technical aspects of publication have been well managed and the illustrations are clear and abundant. Extensive bibliographies are given after the various papers. The book represents a very valuable reference work for cardiologists, cardiovascular surgeons and cardiac physiologists.

COL. WARNER F. BOWERS, MC, USA

J.A.M.A.—CLINICAL ABSTRACTS OF DIAGNOSIS AND TREATMENT. Published with the approval of the Board of Trustees, American Medical Ass'n., Intercontinental Medical Book Corp., with Grune and Stratton, New York. 1955. Price $5.00.

In this one compact volume of 627 pages we find hundreds of carefully selected and well edited clinical abstracts of current medical articles pertaining to diagnosis and treatment, chosen from over 1200 periodicals published throughout the world. These abstracts were selected by Dr. N. D. Fabricant, Editorial Associate of the J.A.M.A. and are arranged in sections acording to 14 Specialties with a complete index at the end. This book "is the first of an annual series of official publications of the *Journal of the American Medical Association.*" Here we have the answer to every physician's desire to obtain up to date, concise diagnostic and therapeutic progress in his own specialty as well as in other medical fields. Thus we are afforded an excellent abstract series of references in book form, to help us keep pace with recent developments in all medical fields. Students, general practitioners and specialists of all kinds will find this a very satisfactory and practical book to own.

COL. H. P. MARVIN, U.S.A., Ret.

PREVENTIVE MEDICINE IN WORLD WAR II. Vol II. Environmental Hygiene. Edited by Col. John Boyd Coates, Jr., M.C. and Ebbe Curtis Hoff, Ph.D., M.D. 404 pages. Office of the Surgeon General Department of the Army, Washington, D.C. 1955. Price (from U. S. Superintendent of Documents, G.P.O.) $3.50.

One of the notable achievements of the Medical Department of the U. S. Army in World War II was in the field of sanitation and environmental hygiene. This book is an interesting and valuable record of the extensive work undertaken under the general direction of the late Brig. Gen. James S. Simmons, director of preventive medicine in the Office of the Surgeon General, and so ably planned and supervised by Col. William A. Hardenbergh, Sn. C., chief of sanitary engineering, and Col. William S. Stone, M.C., chief of sanitation.

In the nine chapters Col. Tom F. Whayne, M.C. discusses Food Management and Housing; Col. Hardenbergh reports on Water Purification, Waste Disposal, Control of Insects, Rodent Control, and the research background of insect and rodent control. In some of these chapters his collaborator is his former associate, Lt. Col. Joseph J. Gilbert, Sn.C. The two concluding chapters are on Foreign Quarantine, by Col. Phillip T. Knies, M.C., USAFR., and on Ports and Persons in Transit by Col. Ralph R. Cleland, MSC.

This well-printed and well-written book is more than a mere historical record of sanitary procedures and accomplishments in the Zone of the Interior and overseas during the late war. It is an excellent text on environmental hygiene, and as such should be required reading at the Service schools. It will also serve as a practical guide for future operations in this field when and if they are necessary.

Although the book is reasonably complete,

there are some gaps in the narrative. The serious typhus fever epidemic in Naples in the winter of 1944-45 receives only one short paragraph, and there is virtually no mention of the excellent activities of the medical and sanitary officers of military government in the ETO and the Pacific. Perhaps these important matters are covered in other volumes in this series.

This book should be indispensable to any member of the military forces who is concerned in any way with environmental hygiene, either now or in the future.

JAMES A. TOBEY, D.P.H.

PHARMACOPEA INTERNATIONALIS. Volume II. Published by World Health Organization. 350 pages. Columbia University Press, New York 1955. Price $6.75.

Volume II of the P. I. has now appeared, to supplement the information in Volume I published in 1951. Both of these books will be available in English, French and Spanish. They represent the considered opinion of international experts, of the drugs and preparations of international importance. The monographs are similar to those in the national pharmacopoeas except for the omission of dosages. The late Dr. Hampshire acted as Chairman of the sessions, followed by Dr. R. Hazard. This Volume consists of 217 monographs for synthetics, crude drugs, and preparations. It has monographs on a number of compressed tablets, sterile injections and tinctures of many substances which appeared in Volume I. The 26 appendices list reagents, test solutions, As, Fe, Pb, and heavy metal limits, analytical procedures and bioassays, and the international biological standards and reference preparations. A very helpful section lists the usual and maximal doses of various products for adults and for children up to 30 months, and from 30 months to 15 years of age. These monographs are intended as recommended specifications, as they may be adopted by various countries, but are not intended to be legal specifications unless so adopted. Any Member State of WHO may include these monographs in their specifications. The book is intended to facilitate international commerce in therapeutic substances. It is noted that a general revision has been started, probably to serve as the basis of Volume III. These two volumes will prove very helpful in connection with any international prescription practice, or purchase of medical supplies any place in the world.

JAMES C. MUNCH

HOSPITALIZATION OF MENTAL PATIENTS. World Health Organization, Geneva, 1955. 100 pp. $1.25.

ALCOHOL AND ALCOHOLISM. Technical Report Series, No. 94. World Health Organization, Geneva, 1955. 14 pp. $0.30.

LEGISLATION AFFECTING PSYCHIATRIC TREATMENT. Technical Report Series, No. 98. World Health Organization, Geneva, 1955. 25 pp. $0.30.

These three pamphlets, published by the World Health Organization of the United Nations, report on the work of committees of experts. The 100-page booklet on "Hospitalization of Mental Patients" discusses the terminology used around the world, the admission and discharge procedures, the safeguards, and the proposed legislation. The 14-page booklet on "Alcohol and Alcoholism" discusses the various types of alcoholism and defines what is considered a problem in the matter of alcohol consumption. This pamphlet very well covers the subject and ends up with a standardized classification of the types of alcoholism. The pamphlet entitled, "Legislation Affecting Psychiatric Treatment," covers 25 pages and is an enlargement on the discussion covered in the first pamphlet mentioned above. These pamphlets should be in every psychiatrist's library.

COMDR. JAMES L. MCCARTNEY, MC, USNR.

THE APPRECIATION OF ANCIENT AND MEDIEVAL SCIENCE DURING THE RENAISSANCE (1450-1600), By George Sarton. 264 pages. Univ. Pennsylvania Press, Philadelphia, 1955.

With his three lectures for the 1953 A. S. W. Rosenbach Fellowship in Bibliography, George Sarton, the old master of science history, opened three windows into the past through which, under his expert guidance, we may see three sides of the ancient and medieval science as it was reborn in the minds of the men of the renaissance period: —medicine, natural history, and mathematics (with astronomy). Sarton shows that the true merit of the renaissance scholars was the rediscovery of the literature of the western past. Their creative activities concerned the publications of their predecessors, and they mostly lacked the true scientific spirit which must be focused upon the future.

By thousands of examples in medicine, anatomy, botany, and allied sciences, Sarton demonstrates that the renaissance had gone into an extreme of overhumanization, just

as much as our own era has progressed into an opposite extreme of overorganization, technocracy, and "dehumanization." He concludes that the quest for truth should go on, but there is more virtue and glory in creating beauty, justice and happiness than in creating wealth. The main text of the slender volume is a store house of interesting facts from the history of science, but much of the author's erudition is hidden in his "footnotes." (It is a pity that these notes were removed by the publisher from their logical place in the text, and attached to the end of the book, which makes their use very difficult for the reader). A few misprints in dates are not worthy of mentioning. All of us who try to appreciate and understand medical achievements and who believe in the unity of science should read these lectures.

CLAUDIUS F. MAYER, M.D.

SURGERY OF THE STOMACH AND DUODENUM. 2nd Revised Ed. (A Handbook of Operative Surgery.) By Claude E. Welch, M.D., D.Sc., Visiting Surgeon, Massachusetts General Hospital. 370 Pages, illustrated. Year Book Publishers, Chicago. 1955. Price $9.00.

This is an excellent book about operative surgery of the stomach and duodenum. The outstanding feature of the book is the combination of many excellent drawings, almost one half of the book together with brief and to the point discussion on the facing pages. The test is very easily read and informal as though the author were present in person. He avoids any long controversial discussions and presents a very detailed but practical step by step approach with the pertinent indications for doing or not doing each method.

There is very brief historical summary that has been added to the front of the book. There are also brief discussions on the adjuncts to any operative surgery on the stomach and duodenum, e.g., anatomy, pre-operative and post-operative treatment, anaesthesia, incisions (both abdominal, transthoracic, and abdomino-thoracic), etc. However, the main body of the book concerns itself with the operative techniques that have been used for duodenal and gastric ulcer and their complications. The difficult duodenal stump is very nicely presented with several alternative methods of dealing with it. Congenital pyloric stenosis, wounds, diverticula, hiatal hernia, tumors, and the late complications of gastric resection have also been covered in their surgical aspects.

The book is particularly recommended for thorough study to younger surgeons and residents in surgery.

RAY N. BROWN, M.D.

COUNSELING IN MEDICAL GENETICS. By Sheldon C. Reed, Director, Dight Institute for Human Genetics, University of Minnesota. 268 pages. W. B. Saunders Co., Philadelphia and London. Price $4.00.

Patients frequently seek the advice of physicians on matters pertaining to genetics. Of course, their questions are not so scientifically expressed nor do they desire an answer couched in scientific terms. Simply asked with a deep concern in their problem, the patient should be given an answer which bears marks of authenticity and not conjecture; an answer not given to hide a lack of knowledge of the subject.

This small book will provide that answer for the physician and should he desire to refer the patient for further advice, the physician will find listed a number of clinics throughout the country especially organized for handling such problems.

The frequency of various diseases and type of inheritance (Dr. Fraser's listing in the *Journal of Pediatrics*) is covered in the appendix of the book. The literature cited and the index, of course, are included.

This is an age of economics and the question, "Shall we have another child" will be asked innumerable times. This easily read book with its case examples will be found to be of great value to the physician, general or specialist.

COL. R. E. BITNER, USA, RET.

SYSTEMIC ASSOCIATIONS AND TREATMENT OF SKIN DISEASES. By Kurt Wiener, M.D., Dermatologist, Mount Sinai Hosp., Milwaukee, Wis. 556 pages, 90 illustrations. C. V. Mosby Co. St. Louis. 1955. Price $17.00.

A sequel to the "Skin Manifestations of Internal Disorders" which dealt with relationship of cutaneous lesions to primarily systemic disease, this book deals with the relationship of internal manifestations to primary cutaneous disease. The author recognizes that there are areas in which both cutaneous and internal manifestations of disease are equally important, and in those instances deals with the subject without stress on either side.

The book is divided into two unequal sections, as to length. The first part contains 28 chapters discussing 19 major skin diseases and pruritis. The discussion deals completely,

though briefly, with the subjects, covering description, etiology, and systemic treatment of each of the diseases. The second part contains 14 chapters dealing with the role of various therapeutic agents used in the systemic management of skin diseases and the role played by diets, spinal roentgen therapy, sympathetic surgery, and the "Spa" therapy of skin diseases. Several pages are devoted to the unorthodox therapy of skin diseases.

The chapters on Lupus erythematosis, scleroderma, leprosy and dermatomyositis deserve special attention because of the author's ability to cover them fully in the most brief manner imaginable. The chapters on Acne and eczema are of great interest since they deal with the subject matter on an extremely practical basis. In the chapters on acne, Wiener clarifies some of the old practices which are still followed, but for which there is little rationale.

The most remarkable aspect of this book is the brevity with which it deals with the subject matter adequately, but which in no way detracts from its readability or its capability of maintaining the reader's interest. The text is well illustrated with examples typical of the entity under discussion.

Because of the extent of its concise coverage of cutaneous disease which is characterized by systemic manifestations, the book is recommended to specialists in dermatology and internal medicine with equal emphasis.

MURRY M. ROBINSON, M.D.

THE PREVENTION OF DISEASE IN EVERYDAY PRACTICE. By Isadore Givner, B.S., M.D., F.A.C.S., Associate Clinical Professor of Ophthalmology, New York University Post-Graduate Medical School; and Maurice Bruger, M.Sc., M.D., C.M., F.A.C.P., Associate Professor of Medicine, New York University Post-Graduate Medical School; and 45 contributors, 964 pages, 50 illustrations. C. V. Mosby Company, St. Louis. 1955. Price, $20.00.

This publication is an excellent collection of chapters by highly qualified contributors from the various clinical and administrative specialties of medicine. It includes an excellent chapter on preventive dentistry. Each is primarily written from the prevention viewpoint. The scope of an undertaking of this nature is tremendous and, as a result, some of the material has had to be foreshortened. However, the volume is a treasurehouse of information related to the prevention aspects of diseases. It should be most useful to practitioners. Most chapters have good bibliographic reference lists. The illustrations are very effective. The health of this nation has materially improved in the past few decades. An awareness and effective practice of preventive medicine by all physicians in everyday practice cannot but further this desirable trend. This complete and easily read book should assist practitioners toward this desirable goal.

COL. JOHN R. HALL, JR., MC, USA

THE POWER OF PERSONALITY IN WAR. By Maj. Gen. Baron Hugo von Freytag-Loringhoven. A translation from German. 167 pages. Military Service Publishing Co., Harrisburg, Pa. 1955. Price $3.00.

A translation of a half-century old classic (Die Macht der Persönlichkeit im Kriege), with the addition of helpful footnotes, this book is an organized extraction of Clausewitz, expanded and expounded with enthusiasm and (generally) convincing logic. The examples are predominantly from Prussian military experience, though Manassas and Mukden come in for mention. Though dated in content, the modern (but faithful) translation gives a book that is current in style.

We will question some details of the arguments, but we must agree with the author's basic philosophy. Either in German or in English this book is of immediate interest to any serious student of the importance of the human element in war.

This translation is particularly welcome at a time when comptrollership makes inroads in command, when mediocrity in mass sometimes gets more homage than excellence in a few, and when, to quote from the book a quote from Scharnhorst—"mechanical thinking triumphs over the qualities of the heart and soul."

LT. COL. DOUGLAS LINDSEY, MC, USA

INTRODUCTION TO VIROLOGY. By Gilbert Dalldorf, M.D., Director, Division of Laboratories and Research, New York State Department of Health, Albany. 102 pages. Charles C Thomas, Springfield. 1955. Price $3.50.

Without a doubt the book is among the best for a condensed introduction into the field of virology. Dr. Dalldorf has an accurate, honest and practical approach to the present day confusion which persists in many aspects of diagnostic virology. The two chapters on the facilities and technics of a diagnostic virology laboratory will be most helpful as a guide.

The introductory chapter on the nature of viruses and also the enigma of aseptic meningitis were very well presented. The strongest contribution to the book was the discussion of the poliomyelitis and Coxsackie viruses. The remaining chapters consider the virus diseases by groups in accordance to the symptoms of infection. The fundamental problems encountered in classification, diagnosis, pathogenesis, and immunology are presented, and basic references are given for further reading.

The book is directed to the hospital laboratory worker, and is quite satisfactory in fulfilling its intent.

LT. EUGENE D. SHAW, MSC, USA

THE HEMORRHAGIC DISORDERS. A Clinical and Therapeutic Approach. By Mario Stefanini, M.D., Associate Professor of Medicine, Tufts University School of Medicine; and William Dameshek, M.D., Professor of Medicine, Tufts University School of Medicine. 368 pages. Grune & Stratton, New York-London. 1955. Price $11.75.

This book is divided into twelve sections dealing with the various aspects of the hemorrhagic disorders from "Alpha to Omega." It is almost encyclopedic in nature, although it is sub-titled "A Clinical and Therapeutical Approach." Emphasis is placed on abnormalities of coagulation and deficiencies in the vascular, the platelet and the fibrinolytic mechanisms. This treatise is based on clinical study, laboratory investigation and bedside teaching in a large number of cases of hemorrhagic disturbances. The approach is primarily that of the clinical investigator who considers laboratory studies to represent only one phase in the management of the patient as a whole. This broad approach is as it should be, since a hemorrhagic disorder is seldom due to any one single defect.

The authors present an alphabetic list of some thirty terms applied to the various factors in blood coagulation. This is an index of the extent and complexity of accelerated research in the general field of hematology, which may be considered but a branch of biodynamics. Indeed, the discussion of the normal hemostatic process is so complex that this reviewer completely bogged down half way through the first chapter.

Although the authors have made an honest effort to stress the details of therapy, the whole gamut of hematology has become so extensive that the general practitioner and/or modest internist may find himself totally at sea until he learns the newer language of the hemorrhagic orders and disorders.

CAPT. CHRISTOPHER C. SHAW, MC, USN

TEXTBOOK OF ENDOCRINOLOGY, 2nd Edition. By Robert H. Williams, M.D., Executive Officer and Professor of Medicine, University of Washington Medical School, Seattle, Washington, and 10 contributing authors. 776 Pages, 173 Illustrations. W. B. Saunders Company, Philadelphia, 1955. Price $13.00.

Dr. Williams has once again headed an "All American Eleven" of Endocrinologists and Clinical Physiologists to produce a truly up to date revision of his "Textbook on Endocrinology." This second edition suffers not the traditional sophomore jinx, but on the contrary surpasses the sterling standards set by its predecessor.

This is a well conceived, smartly planned and brilliantly coordinated book. The illustrations are most instructive and are well placed. There are numerous tables and outlines that enhance the teaching value of the text.

In addition to the chapters on the endocrine glands there are sections on neuroendocrinology, obesity, laboratory procedures and proprietary endocrine preparations that the reader will find stimulating and practical.

The chapters by Dr. Williams are especially good. It is hard to conceive of any question pertaining to thyroid disease that is not answered in that chapter. Drs. Forsham and Thorn's coverage of the adrenal glands and pancreas is brilliant as would be expected from such authorities. They perhaps do use cyancobalamine tinted glasses in viewing therapeutic results obtained from parenteral B-12 in diabetic neuropathies. *Outstanding* is the word for Dr. Reifenstein's chapter on the parathyroid, for his discussion on home metabolism constitutes a real plus value.

This book will have a wide appeal to physicians of many specialties especially internists, surgeons and radiologists. It will be of particular value to general practitioners and military physicians who are concerned with family practice. Anyone who reads this book will sharpen and broaden his understanding of the fundamentals of medicine as well as of endocrinology.

CAPT. JULIAN LOVE, MC, USN

PRACTICAL ORTHODONTICS, 8th Ed., (Original Text by Martin Dewey), Revised by George Anderson, D.D.S., Formerly Professor of Orthodontics, Baltimore College of Dental Surgery, Dental School, University of Maryland. 702 pages, illustrated. The C. V. Mosby Company, St. Louis. 1955. Price $17.50.

The revision of this widely known text has been splendidly accomplished by Dr. Anderson, a most successful clinician, progressive teacher, and distinguished author. In this, the eighth edition, the author has eliminated the obsolete, amplified newer data which has been justified by time, and large segments have been added concerning beneficial measures and methods proven by careful research and clinical practice.

Three of the most important developments in the past decade have assumed major significance in practice today—Anthropometric considerations and cephalometric appraisal; equilibration of occlusion, eliminating disharmonies as well as an aid in treatment; and extraction as an aid to treatment. The author has presented these developments in a most satisfactory manner.

The new material on cleft palate is a distinct addition to dental literature and the new subject of osteoporosis or craniotabes, its effect upon the skull, face and jaws as well as its influence on occlusion, is included.

This is a noteworthy contribution to orthodontic literature and will be a valuable undergraduate text-book as well as a most helpful reference for the earnest orthodontist.

BRIG. GEN. LEIGH C. FAIRBANK, USA, RET.

THE SHOULDER AND ENVIRONS. By James E. Bateman, M.D., F.R.C.S., (C), 565 pages, 376 figures. The C. V. Mosby Co., St. Louis. 1955. Price $16.25.

Dr. Bateman of Canada has presented a book concerning symptoms of this rather extensive region. He divides this book into three broad groups, shoulder and neck pain, predominant shoulder pain, and shoulder plus radiating symptoms. This separates disorders of the region as a whole; individual lesions are then discussed in detail and the pathology, clinical course and treatment are also given. One interesting feature of this excellent book is the presentation of roentgenological studies. The position is illustrated photographically most extensively.

The book is profusely illustrated and the surgical techniques are in particular very beautifully done and clearly demonstrated.

Particularly enjoyable is the section on evolution and applied embryology of the shoulder region. This is brought out with a practical application to the human being and illustrated by photographs of patients and roentgenograms. The chapter on "Applied, Variational and Radiographic Anatomy of the Shoulder" likewise is excellently presented and is a very practical work.

The section on Applied Physiology of the Shoulder, Examination and Investigation, and Differential Diagnosis of Disorders are all well done and well illustrated.

W. COMPERE BASOM, M.D.

WAR-DIARY OF AN ARMY PSYCHIATRIST. By Merrill Moore, M.D. 44 pages. Contemporary Poetry, Baltimore. 1955. Price $3.00.

This is a volume in the Distinguished Poets Series in which the author, eminent Boston Psychiatrist, poetically describes interesting things and events that he saw or experienced during his World War II military service. Herein are 44 pages of poignant poetry that will appeal to medical and lay readers alike.

COL. H. P. MARVIN, USA, RET.

FUNCTIONAL OTOLOGY. By Morris F. Heller, M.D., Ass't Attending Otolaryngologist for Audiology, Chief Audiology Clinic, Mount Sinai Hospital, New York; and B. M. Anderman, M.A., and Ellis E. Singer, M.A. 225 pages, Springer Publishing Co., Inc. New York. 1955. Price $5.50.

The book attempts to cover the entire field of audiology within a comparatively few pages. As a result, some aspects of the area are over-simplified. For example, the construction of sound-treated rooms is made to sound extremely easy, and no consideration is given to the outside environment.

For a general picture of audiology, this book could be placed in the hands of a beginning student in the field. In addition, because of the simplicity of approach and nontechnical manner in which written, there are many portions to which parents of children who are handicapped with a hearing loss, and also hard-of-hearing adults can be referred.

MAJ. JAMES P. ALBRITE, MC, USA

PHARMACOPOEIA OF THE UNITED STATES. Fifteenth Revision, United States Pharmacopoeal Convention, Inc. 1230 pages. Mack Publishing Co., Easton, Pennsylvania, Distributor. 1955. Price $10.00.

The 15th Revision (16th Edition) of the Pharmacopoeia of the United States, in revision since 1950 has been completed. It became the official national standard for its monographed drugs, December 15, 1955.

The revised pharmacopoeia consisting of 1230 pages contain 786 pages of drug monographs and 313 pages of general tests and reagents. There are 838 drug monographs in the revision, 242 of which are new admissions. It is of interest to note that 160 of the monographs in the U.S.P. XIV have been deleted. These many additions and deletions bear eloquent testimony to the pharmacopoeal convention's adherence to the policy statement which appeared in the first edition of the United States Pharmacopoeia in 1820.

A new section of value to clinicians and pharmacists has been added to each drug monograph—a *category* section—which indicates the principal drug therapeutic class or use for the drug or preparation. The "usual dose" for each drug is also stated.

With the rapid progress being made in the field of pharmacology, the United States Pharmacopoeia in recent years is completely revised once every five years instead of once each decade as in the past. This speed up process coupled with the release of interim announcements and supplements makes the Pharmacopoeia a valuable reference to the physician and pharmacist as well as others engaged in drug use and drug standardization activities.

The presence of the latest revision of the United States Pharmacopoeia in the pharmacies of the nation is a legal requirement of the several states.

GEORGE F. ARCHAMBAULT,
PHARMACIST DIRECTOR,
USPHS

THE NATIONAL FORMULARY, Tenth Edition. Compiled and edited by the Committee on National Formulary. Published by the American Pharmaceutical Association, Washington, D.C. Distributed by J. B. Lippincott Company, Philadelphia, Pa. 867 pages. Price $9.00.

The recently published Tenth Edition of the National Formulary represents one of the most extensive revisions of its entire history extending over a period of 67 years. This edition is the result of work of the Committee on National Formulary, supplemented by advisory committees, extending over a 5-year period.

In the course of the revision, 474 of the 717 N. F. IX monographs were continued in N. F. X. The deletion of the unprecedented number of 243 items is accounted for, in part, by the rapidity with which drugs become obsolete, and in part by the fact that a substantial number of N. F. IX monographs was admitted to U. S. P. XV on the basis of their therapeutic or pharmaceutical essentiality.

Despite the inherent limitations on scope because of the book's legal status, a section on "General Information" has been added as a new and useful feature to the new edition of the National Formulary. In this new section will be found general information relating to balances, weights, and measuring devises; chiropody- podiatry drugs and preparations; clinical laboratory reagents and staining solutions; certified coal-tar colors; the International Pharmacopoeia; optical crystallographic characteristics of drugs; and a chapter on sterilization.

The style and format of the Tenth Edition of the National Formulary are essentially the same as in N. F. IX. A new and useful feature added to each monograph gives the main pharmacological or pharmaceutical category of the drug or preparation covered. The usefulness of the book has been enhanced by a streamlining of the general index and the addition of indices preceding the General Notices, the General Tests, Processes, and Apparatus, and the new section on General Information. The new edition is attractively bound in a durable blue Fabrikoid, and the printing is of the same quality as in previous editions of the National Formulary.

The publication of the new edition will be of particular interest to practing pharmacists and to manufacturers of pharmaceuticals and basic medicinal chemicals and like its predecessors, constitutes a distinguished service of the American Pharmaceutical Association to the development of effective legal standards for drugs. It also serves as a useful reference book on the characteristics of a large number of widely used drugs and therapeutic preparations.

Like the U.S.P. XV, the N. F. X became official December 15, 1955. Also like the U.S.P., the N.F. is a required reference by state law, for the pharmacies of the nation.

GEORGE F. ARCHAMBAULT,
PHARM. DIR., USPHS

INTRACRANIAL GLIOMATA, SOME CLINICAL, RADIOLOGICAL AND THERAPEUTIC ASPECTS OF 298 CASES. By John Penman and Marion C. Smith (Medical Research Council Special Report Series No. 284), British Information Service, 30 Rockefeller Plaza, New York 20. Price $.95.

This well prepared monograph presents the results of a numerical inquiry into certain aspects of the intracranial gliomata, namely their main clinical features, their radiological signs and their responses to surgery and radiotherapy. The material consists of 298 cases collected over the ten year period of 1937-1947 at St. George's Hospital, London, England. Excellent tables analyzing the pathology, sex, age, tumor sites, cardinal symptoms, and length of illness prior to hospitalization; radiology, surgery, and radiotherapy; length of quality of life after admission, whole length of the illness, and value of treatment are presented. Their conclusions are those generally accepted, with comments as to the quality of survival, and questions as to the value of radiotherapy with a plea for its more accurate assessment being pertinent and stimulating.

The material is well prepared, is a useful addition to the clinical literature on gliomata, and is a valuable adjunct to the information of all those concerned with the problem.

LT. COL. JAMES F. HAMMILL, MC, USA

APPLIED MEDICAL BIBLIOGRAPHY FOR STUDENTS. By William Dosite Postell, Medical Librarian and Professor of Medical Bibliography, Louisiana State University School of Medicine. 142 pages, illustrated. Charles C Thomas, Springfield. 1955. Price $4.50.

This is one of the monographs in the Bannerstone Division of American Lectures in Internal Medicine. It is an excellent little book, intended primarily for students of medicine and the allied professions of pharmacy, dentistry, and nursing; but of use to anyone engaged in making research reports, writing scientific articles, or editing and printing such material.

The book is divided into three parts. The first is an historical section and deals with the development of the manuscript, the printed book, and the various types of periodical literature. The next section is devoted to the organization of the medical library, its indexes and basic reference works. The third main subdivision is given over to the methods of bibliography. Here the principles of scientific investigation, the preparation of professional papers, case reports, documentation, footnotes and other pertinent materials are carefully considered. There is an appendix with a list of texts, study questions, and recommended readings. There is an adequate index and the format and typography of the book are very fine.

Medicine has become so vast a field that the importance of the medical library as the repository of medical knowledge has been greatly enhanced. There is no question but that acquaintance with bibliographic methods is becoming more and more necessary. Yet over a number of years this is the first book on medical bibliography that has come to the attention of this reviewer. It is unquestionably a useful introduction and guide to the subject.

CAPT. LOUIS H. RODDIS, USN, RET.

COMPANY ADMINISTRATION AND THE PERSONNEL SECTION. 24 Ed. By Colonel C. M. Virtue. Military Service Publishing Company, Harrisburg, 1955. 412 pages. Price $3.75.

That this venerable work is as up-to-date as a Master Specialist's stripes or the decimal point in a 5-digit MOS is evidence of the triumph of Virtue over formidable odds. Keeping up with changing regulations and changing policies has required 27 revisions since 1933. Half of these have been in my time; using the author's introductory words I can confirm that a *current* edition of the book is valuable as a "comprehensive guide" to regulations and a "handy reference for the administrative personnel" of a company, detachment, group, or hospital.

Valuable as it is, such a manual can never be as complete or as accurate as the regulation itself. The book alone should never be used to decide an argument or determine an official action.

The paper and typography are familiar to the reader of any other book by the same press. The skimpy index does not do justice to the wealth of content. Errors, inconsistencies or omissions are almost inevitable in a work of this type, but they are commendably few, and generally insignificant.

I note with sympathy that an officer with serial number 0 38 634 is still on the Morning Report of a rifle company, in grade of Second Lieutenant. Most of us who were integrated in 1946-47 have done somewhat better than that.

LT. COL. DOUGLAS LINDSEY, MC, USA.

OF RESEARCH PEOPLE. By George E. Burch, M.D., F.A.C.P. Henderson Professor of Medicine, Tulane University School of Medicine, 56 pages, illustrated. Grune & Stratton, New York and London. 1955.

This is the Presidential address which the author presented at the ninth annual meeting of the Southern Society for Clinical Research in Jan. 1955. In a very direct, authoritative manner Dr. Burch discusses the many real problems and difficulties that beset present day investigators. He discusses the various types of individuals who attempt research studies. Remedies are offered to iron out the many ills noted in research activities. Clever illustrations enhance the value of this excellent presentation which should be read and thoroughly digested by all who are interested in research activities of any type.

COL. H. P. MARVIN, USA, RET.

ASSAULT BATTLE DRILL. By Maj. Gen. James C. Fry, U. S. Army. 114 pages, illustrated. The Military Service Publishing Co., Harrisburg, Pa. 1955. Price $2.50.

Neither the author nor the publisher need credentials, so the book stands on its own merits. They are considerable.

It is not a re-hash of the training manuals. It presents forcefully and in detail something which the author feels the official literature does not cover—not just *what* should be done, but *how* to do it: how to take an objective and stay alive.

It reads easily. The few fictional situations have the ring of reality. There is a solid structure of short, pertinent, and detailed historical examples of the actions of Privates and Lieutenants, Squads and Platoons, Marines and Cavalry. The personal appeal is strong: for the individual on the battlefield "Success and survival are synonomous" (sic).

It makes sense. General Fry states early his disagreement with the premise that men committed to battle must learn the hard way. He shows how few are the moving pieces on the chessboard of battle. He shows how to train men in the few moves they can make (left, right, or straight ahead).

It is valuable for us. Since the function of the medical service is to support the combat arms, it is always well to know more about how those arms work. But there is more. Too often I have seen a graduate doctor of medicine and several high-skill-level technicians break down in the face of a sudden casualty load.

We might develop a little battle drill ourselves.

LT. COL. DOUGLAS LINDSEY, MC, USA

THE RELIEF OF SYMPTOMS. By Walter Modell, M.D., Associate Professor, Clinical Pharmacology, Cornell University Medical College. 450 pages. W. B. Saunders Company, Philadelphia & London. 1955. Price $8.00.

The author states in his preface that the object of this treatise is to serve as a guide to the problems of providing the patient with relief from his distress. He states that most textbooks have as their objective the diagnosis of the pathology. He lists twenty-four symptoms, which he maintains account for ninety-five percent of those which bring patients to the doctor's office. In the first five chapters he analyzes the meaning of symptoms, while in the next twenty-four chapters he discusses the specific symptoms and the methods of relieving them. In the final chapter he discusses the "masking of symptoms" by the use of therapeutic agents.

The author states that this volume has been an outgrowth of formal lectures and informal seminars with medical students, and he emphasizes that it is addressed primarily to medical students and younger graduates. There is much that he says that might be challenged by other authorities, but his approach is stimulating. At the end of each chapter he gives a summary of his conclusions and selected references which may be used for further study. His chapter on the "Placebo Action of Drugs" is indeed refreshing and is a fact that is frequently overlooked by the practitioner. He emphasizes the art of medical practice.

On page four he states: "It is too often the cultist, the charlatan or the unscientific practitioner of medicine who consciously and purposefully directs his main efforts to the satisfaction of the patient's request—the relief of his symptoms. And this seems to be because, unlike the bona fide healer, relief is what they have to offer and all they have to offer; they cannot afford to be high-handed about the symptom. Yet it is the normal, natural and understandable right of the patient to have relief, and there are in our culture no moral reasons for refusing it."

COMMANDER JAMES L. MCCARTNEY, MC, USNR (RET.)

INFANT NUTRITION IN THE SUBTROPICS AND TROPICS. By D. B. Jelliffe, M.D., M.R.C.P., D.C.H., D.T.M.& H. World Health Organization Monograph Series No. 29—185 pages. Columbia University Press. Price $4.00.

This treatise is the result of a comprehensive study by the author on the subject in the Eastern Mediterranean, South-East Asia, and Western Pacific regions. There are 313 references in this well organized work with appropriate and excellent illustrations depicting syndromes associated with various deficiency diseases encountered.

The study is made with a view of serving as a basis by which to improve child health in relation to nutrition in the tropics and subtropics. This book outlines the methods of feeding now in use and emphasizes the main problems involved.

The information will be of interest mainly to those individuals immediately concerned with child health in these areas but it will prove worthwhile reading to all who are interested in infant nutrition because the problems to some extent are similar to those encountered in temperate regions.

Kwashiorkor, a nutritional syndrome due to protein deficiency in the period of late breast feeding, weaning, and post-weaning phases of development is particularly well described and discussed.

CAPT. JOHN R. HANSEN, MC, USA

NEW BOOKS

Auscultation and Diseases of the Chest (R. T. H. Laennec, 1823-1830). A Reproduction of the translation from the French, by John Forbes, M.D. Phila., 1823. Dept. History of Medicine, Univ. of Buffalo. 1955. Price $1.50.

Experimental Tuberculosis. Bacillus and Host, with an Addendum on Leprosy. Editors for the Ciba Foundation G. E. W. Wolstenholme, O.B.E., and Margaret P. Cameron, M.A., assisted by Cecilia M. O'Connor, B.Sc. Little, Brown & Co., Boston, Mass. Price $9.00.

A Follow-up Study of World War II Prisoners of War, by Bernard M. Cohen, Ph.D. and Maurice Z. Cooper, M.D. VA Medical Monograph. Supt. of Documents, U. S. Government Printing Office, Washington 25, D.C. Price $1.50.

Practitioners' Conferences, held at The New York Hospital-Cornell Medical Center, Vol. 3. Edited by Claude E. Forkner, M.D. Appleton-Century-Crofts, New York, N.Y. Price $6.75.

Diagnosis and Treatment of Vascular Disorders (Angiology), by Samuels. The Williams & Wilkins Co., Baltimore, Md. Price $16.00.

Operative Dental Surgery, 7th ed., by Parfitt & Hebert. The Williams & Wilkins Co., Baltimore, Md. Price $9.00.

Public Health Service: Stereoscopic Manual of Venereal Disease, 1 vol., 39 pp., 14 reels, 98 views. The Williams & Wilkins Co., Baltimore, Md. Price $15.00.

Clinical Interpretation of Laboratory Tests, by Raymond H. Goodale, M.D. F. A. Davis Co., Philadelphia, Pa. Price $7.50.

A Course in Practical Therapeutics by Martin E. Rehfuss, M.D. and Alison H. Price, M.D. The Williams & Wilkins Co., Baltimore, Md. Price $15.00.

Doctor and Patient and the Law, by Louis J. Regan, LL.B. The C. V. Mosby Co., St. Louis, Mo. Price $12.50.

The Biliary Tract, by Julian A. Sterling, M.D. The Williams & Wilkins Co., Baltimore, Md. Price $10.00.

Tuberculosis in the Army of the United States in World War II. An Epidemiological Study with an Evaluation of X-Ray Screening, by Esmond R. Long, M.D. and Seymour Jablon, A.M. VA Medical Monograph. Supt. of Documents, U. S. Government Printing Office, Washington 25, D.C. Price $1.50.

Excitabilite Neuro-Musculaire et Equilibre Ionique, by H. Laborit and Mme. G. Laborit. Masson et Cie, Editeurs, Paris, France, Price 880 fr.

Practice in Radiotherapy, by Sir Ernest Rock Carling, LL.D., F.R.C.S., B. W. Windeyer, M.B., B.S., D.Sc. and D. W. Smithers, M.D., F.R.C.P. The C. V. Mosby Co., St. Louis, Mo. Price $20.00.

An Atlas of Otolaryngic Pathology, by Col. J. E. Ash, MC, USA, Ret. and Muriel Raum, M.D. American Registry of Pathology, Washington, D.C. Price $20.00.

1956 Current Therapy, edited by Howard F. Conn, M.D., W. B. Saunders Co., Philadelphia, Pa. Price $11.00.

Christopher's Textbook of Surgery, edited by Loyal Davis, M.D., 6th ed. W. B. Saunders Co., Philadelphia, Pa. Price $15.50.

Royal Air Force Medical Services. British Information Service, 30 Rockefeller Plaza, New York 20, N.Y. Price $13.31.

Diseases of the Chest, by H. Corwin Hinshaw, M.D., Ph.D. and L. Henry Garland, M.B., B.Ch. W. B. Saunders Co., Philadelphia, Pa. Price $15.00.

A Modern Pilgrim's Progress for Diabetics, by Garfield G. Duncan, M.D. W. B. Saunders Co., Philadelphia, Pa. Price $2.50.

Surgical Diagnosis, by Philip Thorek, M.D., F.A.C.S., F.I.C.S., J. B. Lippincott Co., Philadelphia, Pa. Price $12.00.